APRIL 1954

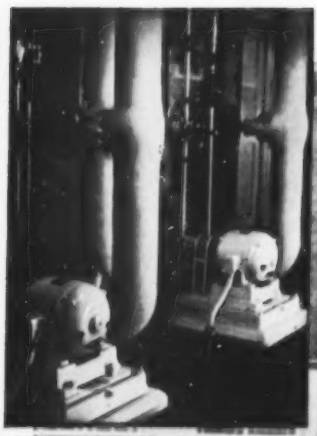
Power Engineering

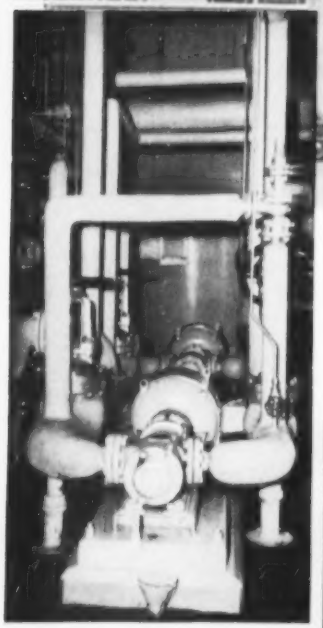
Grogan's Graphical Method for Figuring Natural Chimney Draft 61
How Much Unnecessary Noise Does Your Plant Make? 62
Precast Panels Speed Construction of Utility Buildings 65
Ultra Modern New Kearny Units, Numbers 7 & 8 66
Diesel Powers Mountain Plant at 15,800 Feet 69
A New Power Plant Problem – Who'll Buy My Fly Ash? 70
Automatic Hard-Facing of Worn Pulverizer Parts Pays Off 72
Here Are Several Ways to Get Hurt in a Substation 74
What Are Anti-Smoke Laws Worth? 75
New Extruded Pipe for Novel New Steam Tracing Idea 79
Practical Pointers on How to Install Duplex Tubing 80
Power Engineering Refresher . . . A-C Generators in Parallel 84
Removing Oil from Water by Flocculation and Filtration 86
Hanford Now Utilizes Waste Heat from Atomic Reactors 88
Hints on Figuring Flow and Losses in Small Piping 92

REGULAR DEPARTMENTS

Engineers' Preview 3
Editorial and Business Staff 3
Helpful Bulletins 25
Equipment News 42
Construction News 48
News Reel 82
Practical Engineer and Electrician 90
Readers' Service Post Cards 113
Advertisers' Index 148
Circulation of this issue 33,884

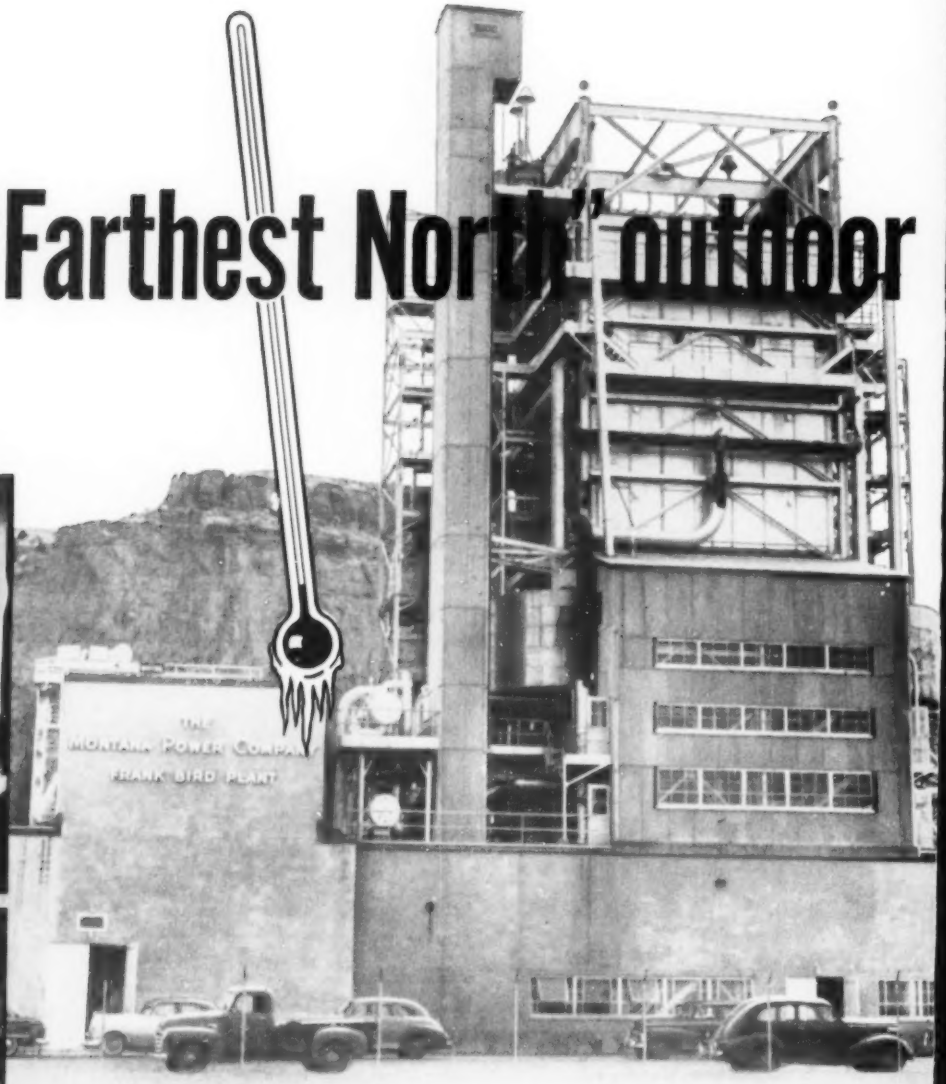
In this "Farthest North" outdoor





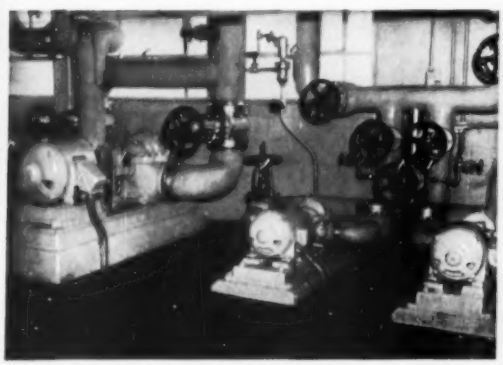
Some of the many Elliott C-W motors on pumps for oil burners, fuel oil transfer, condensate transfer, etc., as well as a number of other auxiliaries.

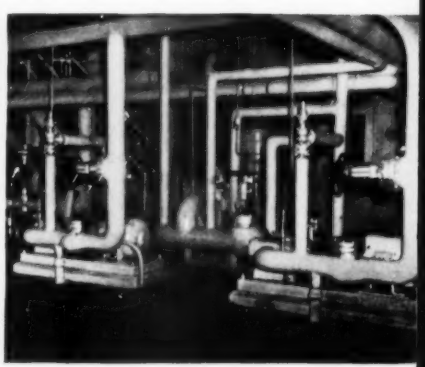
Q3-6



Winters can be severe on the rugged banks of the historic Yellowstone River, where the Frank W. Bird plant is located.

The station was designed and constructed by Ebasco Services, Incorporated.





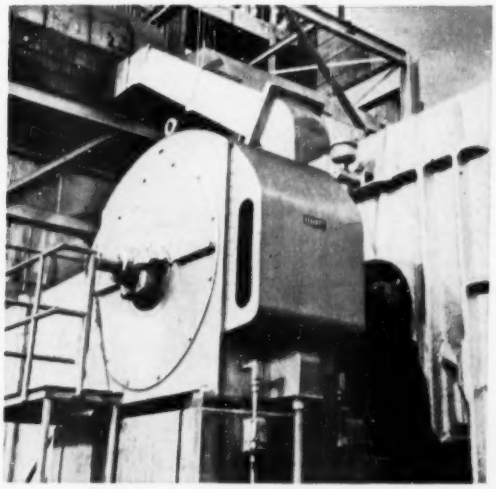
type station...

ELLIOTT MOTORS

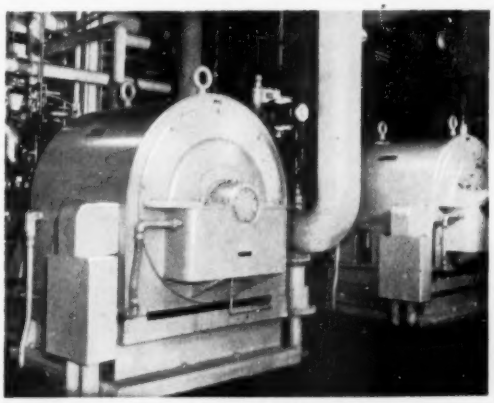
FORTY BELOW is not an uncommon winter temperature at the Frank W. Bird Steam-electric Station of the Montana Power Company, near Billings. Blizzard conditions too, naturally. Pretty tough sleddin' for exposed equipment, but not too tough for the Elliott 1000-hp motor driving the induced draft fan in the picture at the right. This is the increasingly popular outdoor splashproof (weather-protected) design that needs no ducts nor cored foundation. A similar motor of vertical type, 500-hp, drives a circulating water pump located on the exposed river bank. Other large Elliott motors serve the plant in less exposed locations, as well as a number of Elliott Crocker-Wheeler motors of open dripproof type on auxiliaries —quiet, capable performers, all doing their share in holding station costs down.

Your local Elliott representative or district office will give you complete data on the Elliott motors mentioned, or any other types you may need. Or write Elliott Company, Jeannette, Pa.

Out on the open river bank, buffeted by bitter winds, snow, sleet, etc., this Elliott 500-hp 12-pole vertical outdoor splashproof (weather-protected) motor drives a circulating water pump.



This Elliott 1000-hp outdoor splashproof (weather-protected) motor drives an induced-draft fan.



Two 1250-hp two-pole squirrel-cage induction motors on boiler-feed pump service.

ELLIOTT Company

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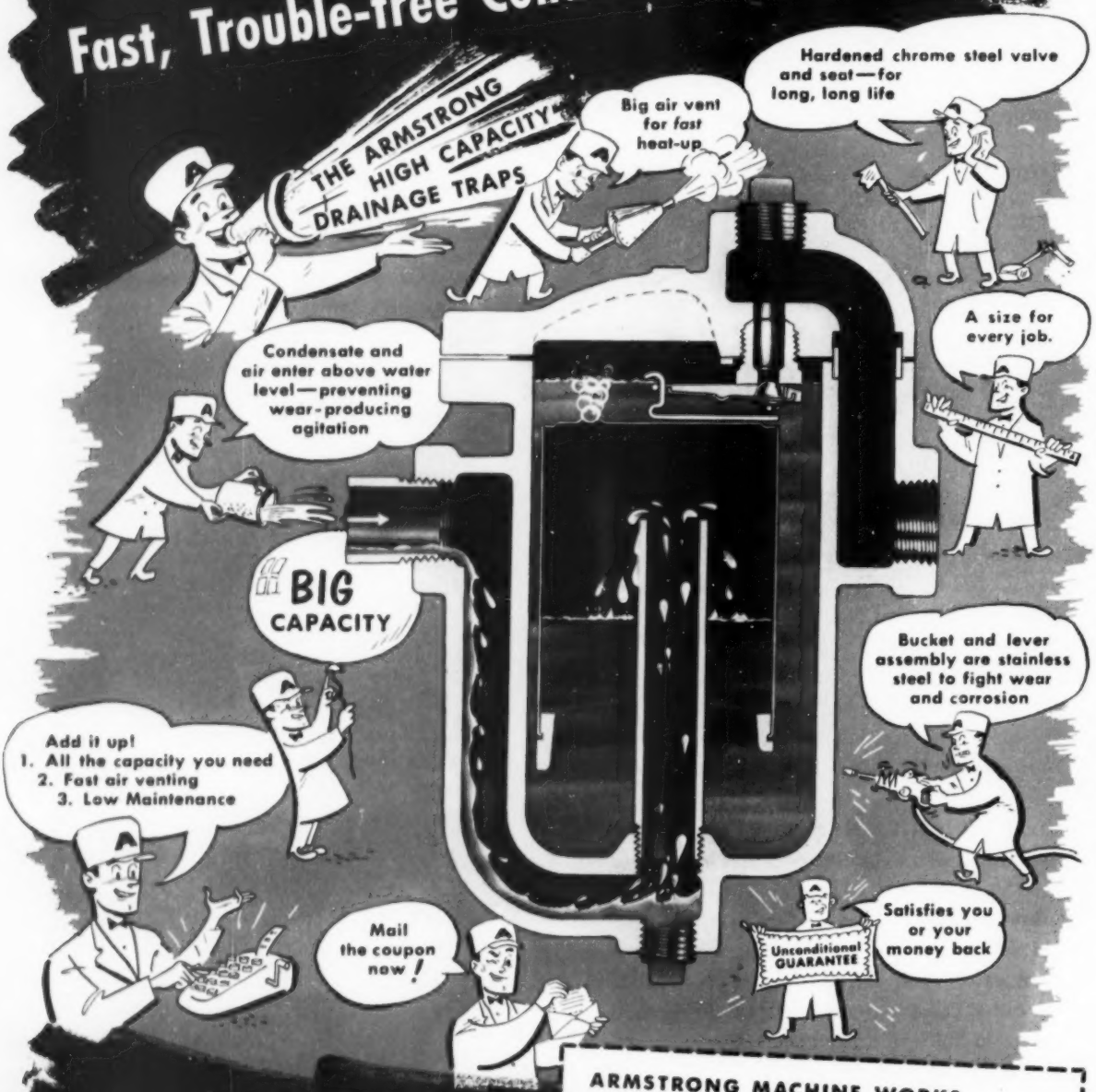
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ENGINEERS' PREVIEW

WHY STUDY MATH? We have been asked that question many times by young people of high school age and also by their parents; and we assume you have been asked it too. In many cases, these young people are trying to decide what is to become of them when they get out of high school, and they want to know whether it is important for them to study math. If they are planning to go to college, the question remains essentially unchanged.

The answer is: No matter what the young man or woman plans to do when he or she gets out of high school or college, he's probably going to need more mathematics. Recognizing the importance of giving young people some really practical down-to-earth advice on this subject of why study math, General Electric has put out an 8-page bulletin giving all the reasons why they need more math. It also gives a number of practical examples of how these young people will need to know something about it whether or not they go into engineering.

If you are cooperating with your local high school in any of the various guidance programs now going on, or if you are working with any of the ASME educational groups, or if you need copies of this booklet for your own use or for your friends, just write the EP editor and we'll see that you get one.

* * *

PRODUCERS of 85 per cent magnesia and diatomaceous silica insulations have adopted new simplified thicknesses for pipe insulation. These will aid specification writing and permit the use of all sizes and thicknesses in double-layer construction. New thickness tables for these values result from collaborative effort of the Technical Committee members of The Magnesia Insulation Manufacturers Association. Copies of the tables can be obtained from the association at 1317 "F" Street, N. W., Washington 4, D. C.

* * *

UNIT First-Aid Kits, for field and small plant use, have proved to be more practical than bulk first-aid supplies for the use of a small number of workers in a group or small groups detached from a central location, groups working in isolated areas where immediate medical attention is not available and crews on mobile equipment.

In cooperation with industry, the Division of Simplified Practices, U. S. Bureau of Standards, has written Code R178-41 to simplify maintenance of industrial first-aid kits and establish commercial standards for sizes of unit cartons and kits. The intent is to facilitate handling and economical replenishing of dressings and to eliminate the necessity of repackaging and rewrapping them. The contents of the kits do not spill, leak, or deteriorate; they remain clean and sanitary.

For full information about these unit first-aid kits, ask the National Safety Council, 425 N. Michigan Ave., Chicago, Ill. for a copy of Data Sheet D-202.

* * *

NEW SERVICE for on-the-line repair of high-pressure valves has been announced by one machine company in the East. Instituted as an adjunct to the concern's regular valve-reconditioning activities, the new service is designed to cut outage time costs by making on-the-line repairs where conditions are favorable.

All types and sizes of worn-out valves are reconditioned by the company in its shop as well as in the field, including cast and forged steel, stainless, nickel, Monel and bronze, with working steam pres-

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POWER ENGINEERING IS PUBLISHED MONTHLY • 110 S. DEARBORN ST., CHICAGO 3, ILL. DEARBORN 2-5446

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Subscription Information: Published monthly; price in the United States and its possessions $10, in Canada $11, in other countries $12 per year; single copies $1.00.

Micro film edition $4.75 annually from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

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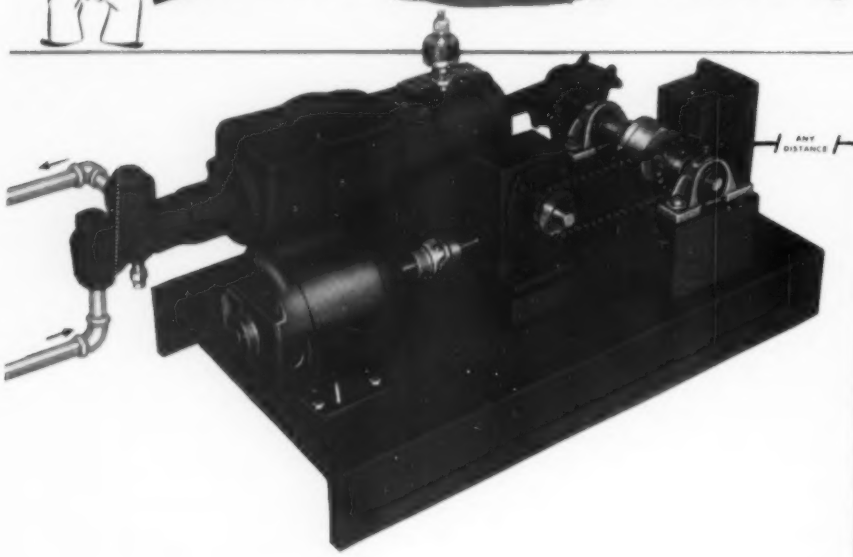
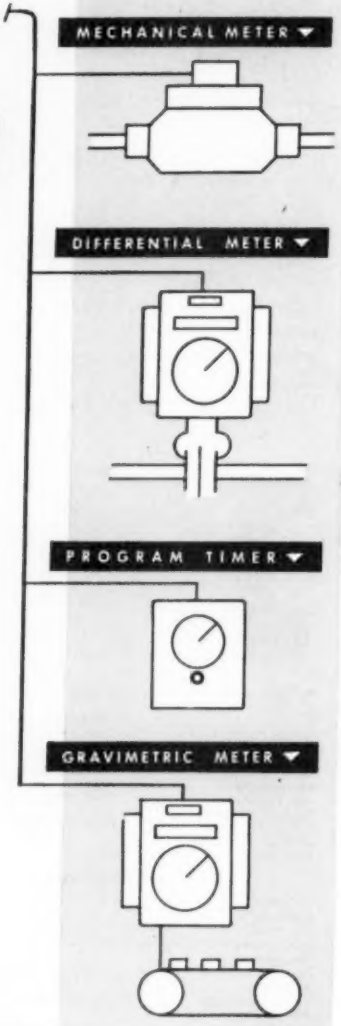
PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

NEW PROPORTIONAL WATER TREATMENT

...directly without specialized controls





PROPORTIONEERS new Adjust-O-Feeder automatically regulates the feeding of treating chemicals in proportion to demand. Fluctuations in the metered variable are converted to integrator contacts which in turn regulate the number of strokes of the Adjust-O-Feeder metering pump.

This new unit meters and feeds chemicals in prescribed dosages to power plant water supplies for boiler water conditioning, condenser and cooling tower water treatment.

Adjust-O-Feeder metering pumps are built in a wide range of sizes, types and materials of construction to suit any field problem requiring quantities from cubic centimeters to gallons per minute and against both low and high pressures.

Ask for information and recommendations. Proportioneers, Inc., 385 Harris Ave., Providence 1, R. I.

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TECHNICAL SERVICE REPRESENTATIVES IN PRINCIPAL CITIES OF THE UNITED STATES, CANADA, MEXICO AND OTHER FOREIGN COUNTRIES

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sures from 150 to 2500 psi.

Where conditions preclude on-the-line service, the concern offers pickup and delivery within 600 miles. Compatible freight rates are arranged for more distant points.

Reconditioning comprises complete disassembly of valves, after which each part is cleaned and inspected for misalignment and wear. Rethreading of seats, manufacturing of new seat rings, remachining of flanges and hard facing with proper materials are performed where necessary. Additional information and descriptive literature will be furnished by the company upon request. If you want it, write the EP editor.

* * *

FIRST APPLICATION in quantity of new rectifier equipment to multiple-unit railroad cars will be made on the New York, New Haven and Hartford Railroad early this year, it was reported at the winter meeting of the AIEE.

One hundred such cars, using ignitron-rectifiers to convert 11,000-v, 25-cycle a-c from the trolley to nominal 600 d-c, will soon be placed in service, according to Ames, Hutchinson and Moore of Westinghouse. The rectified power will operate four spring-supported motors on each car.

* * *

WORLD'S two most powerful transformers, each rated at 315,000 kva, will be built by Westinghouse for the Detroit Edison Company. Each transformer will raise the power output of a generator from 17,300 v to 129,000 v. Most powerful transformers previously built are four 190,000-kva units that Westinghouse built for the St. Clair Station.

* * *

DETROIT EDISON has appointed two new assistant managers of engineering and regrouped its engineering organization by creation of three new departments. The two new assistant managers of engineering are Edward R. Moore, former chief engineer of the engineering department and Harvey A. Wagner, former assistant chief of the same department. Regrouping in the three new departments is as follows.

Design engineering department: Director, Edward L. Nugent, former assistant supervising engineer in Construction Engineering; assistant director, James N. Livermore, former mechanical division engineer, Construction Engineering.

Engineering Coordination and Services Department: Director, Simon Roth, former supervising engineer in Construction Engineering; assistant director, Willis E. Losie, former staff supervising engineer, engineering department.

Planning and Project Engineering Department: Director, W. Fred Wetmore, former chief electrical engineer, Engineering Department and assistant director, and Harold C. Reasoner, former operating engineer of power plants, Production Dept.

LETTERS TO THE EDITORS

More on Power Factor and Voltage Control

BEFORE THE ARTICLE of E. H. Stivender (in your November 1953 issue) is entirely forgotton, I wish to give you a discussion on what aroused my interest. The condition I wish to describe occurs less frequently as electrical progress solves more of the problems in electrical transmission systems. But it was a real problem at that time and had a few interesting phases in its solution.

Much of the system where these events occurred was still st 6.6 k.v. single phase and 11 k.v. three phase at the time I went to work in the main plant. From a technical viewpoint, those voltages at the load available, were about the most practicable because the inductive and copper losses along the line were sufficient to balance the capacitative component at any hour of the day.

There were four plants, one hydro, and three diesel, along three hundred miles of line. They were placed at convenient spots where the larger loads had grown up, and in general they pulled along together very nicely. No one, at that time, complained. The operators took care of their equipment and the local voltage situation; all was well.

No one paid much attention to frequency either. More or less, all they did was put on more engines for peak load, or speed up a little. That raised the system frequency, and of course, the few electric clocks didn't keep good time. The owner of an electric clock had but one advantage, he did not need to wind the clock. It did seem strange, however, when he found his clock running fast some days — slow some days, and sometimes they were accurate, perhaps varying with the day of the week.

To add a measure of voltage boost between stations, it was customary at some hours of the day, to bring in some of the old abandoned 25, 50, or 100 k.w. units and run them as synchronous condensers. They were overexcited to compensate for voltage drop; attendant stayed at the plant only a few minutes to assure proper rheostat setting and lubrication.

As some lines were changed from 6.6 k.v. single phase to 11 k.w. three phase, and others from 11 k.w. three phase to 33 k.v. three phase, the lack of IR drop became very noticeable, and the cooperation between plants began to dwindle. They accused one another of raising the voltage too high. Orders had to be issued to reduce excitation, but that didn't restore the "family spirit."

As the boost in line voltage progressed, there came the time when excitation was so low that generators and exciters were operating far below the "knee" of the saturation curve. For almost any reason whatever there would come a moment at any plant with the regulator contacts open too long, and excitation would drop to zero. Then would come a surge from the other plants on the line. If at least one station wasn't stable enough to hold the other stations in step "there would be heck to pay."

The surges of power at such a time might have been somewhat in the nature of electrical resonance or they might have been a natural surge to restore stability. At all events, it always required cutting the system dead, opening section switches, reclosing in sections and then synchronizing. On one occasion the hydro-plant had been left for the night and the operator had gone home to bed. This plant had a lengthy section of its own with too much load for either unit alone. On this occasion it kept on grinding at low voltage and low frequency. It took an hour to rout out the operator by phone to correct the situation.

The condition became so bad that during one six-week period we had only one interval of two hours without a power interruption.

Of course, one usually attacks such a problem from the angle of how it

affects the equipment at his own plant. No one realized the fundamental basis of these disturbances. So everyone experimented. We soon learned the minimum value of current and voltage on an exciter necessary to give stable control. When it became necessary to operate more than one unit at a plant to absorb the leading power factor current, the men were taught to keep at least one exciter in stable condition, that is, above the knee of the saturation curve. One exciter at such a time gave an astonishing measure of control. Many times on Sunday the engines at our plant ran fully idle, not even generating current for station auxiliary equipment or lights.

The first break came one day when the "abandoned generators" were ordered off the line. Our required excitation increased 25 per cent. As a further move, one of the three diesel plants was shut down. We gained a little more. The condition was carried a bit further but regulation along the system suffered, so the two remaining diesel plants and the hydro plant remained in regular 24-hour service. The third diesel plant operated thereafter only during peak loads.

At this point I wish to insert my analysis of conditions as they had affected the power system. The voltage-raising effect of leading power factor, as determined by construction of the lines, had been pretty well offset by previous resistance drops and inductive load. To maintain voltage during peak loads, the "floating" generators on over excitation had taken care of excessive localized-voltage drops. With a general boost to the higher voltages the flow of current, and consequently resistance drops, were reduced in one large jump. With plant operators attempting to "hang onto" their previous excitation values, the voltage tended to swing up. One plant insisted on operation at near "unity power factor or else." Added to this were the "floating" generators. They, too, were running at previous excitation. Manifestly some one had to "give" and our plant as main stabilizer "gave."

With removal of the "floating" equipment, a portion of the high voltage trouble disappeared and left only the "unity power factor plant" and the capacitative current from the lines to cope with. The next step was an enforced "re-education" on plant and system operation as affected by high voltages. But there still was a need for further control and that was achieved by the installation of a set of inductive reactors. The equipment manufacturer sent a man to do a survey on the system and I enjoyed the time he spent at our plant while we set up various line and plant conditions on which to base his calculations. He did his job very well, and after the equipment was installed we had an almost immediate development of the original cooperation between plants.

As a last "exercise" in our tests that day, the factory man requested a demonstration of operating a generating unit with zero excitation from the d.c. bus. In our discussion I had mentioned this condition as having occurred many times. He wanted to see it, and with the aid of our crew we obliged. His only comment was, "I didn't know it could be done." Although the generators were built by his company he had not observed the pole-face amortisseur windings, which under that condition changed generator operation from synchronous to inductive.

I wish to express appreciation for your magazine. The advertisements take as much of my time as the editorials and articles — *A. W. Gratke, Poplar Bluff, Mo.*

Wire Fence Painting with Roller-Coater Brushes

WE ARE interested in your article by L. G. Jones ("What Does Painting Cost?") in the October, 1953 issue of POWER ENGINEERING.

In particular we have, here on Okinawa, a large number of miles of security fencing, almost identical to that in the illustration marked Fig. 2. Little is known locally about the efficacy of painting this chain-link fence with rollers. Would it be possible for us to get in touch with the author through your offices, to determine the type of roller used in this operation, how thorough a coverage results, and what viscosity of paint is recommended for use with rollers — *O. E. Roller, Okinawa.*

Editor's Note: Mr. Roller is Chief, Engineering Section, Engineer Activities Ryukyus Service Command, 8116th Army Unit. We forwarded his letter to Mr. Jones, who replied as follows:

YOUR LETTER of November 28, 1953 was referred to me by the editors of POWER ENGINEERING magazine. Here are some answers to your questions on painting security wire fences with roller-coater brushes.

1. Length of rollers — 13.5 in., equipped with extension handles.

2. Paint is mixed with approximately 30% of thinner by volume. The best paint holders as shown are sheet-metal inclined flat containers holding up to 1½ gallons. The rollers are immersed in the deep end, then rolled back and forth on the exposed inclined area to expel excess paint, like wiping a brush on the inside lip of a paint can.

3. Paint is applied best to the fence fabric, barbed wire, railings and posts, by two men on opposite sides facing each other, working vertically on the fabric and posts; horizontally on the rails and barbed wire.

4. A tarpaulin under the fence catches the dripping. Some paint can be reclaimed by rolling the squeezed rollers into the paint caught on the tarpaulins as the job progresses.

5. Parts that cannot be coated by the rollers can be brushed or sprayed, as may be handiest.

6. Use corrosion resistant paints on steel or galvanized fencing. The galvanized wire or surfaces should be well weathered or etched to hold the paint permanently.

E. J. Higgins, American Gas & Electric Service Company, published the following data in *Electrical World*, December 15, 1952.

1. Roller coaters are fabricated from synthetic lamb's wool which absorbs paint readily.
2. Paint can be a multiple pigment of red-lead-zinc powder for a ground coat, covered with aluminum or other finish; or a Zincilate, ZRC, Galvanite or Subalox for a good one-coat job.
3. In 324 lineal feet of fence, the results were:

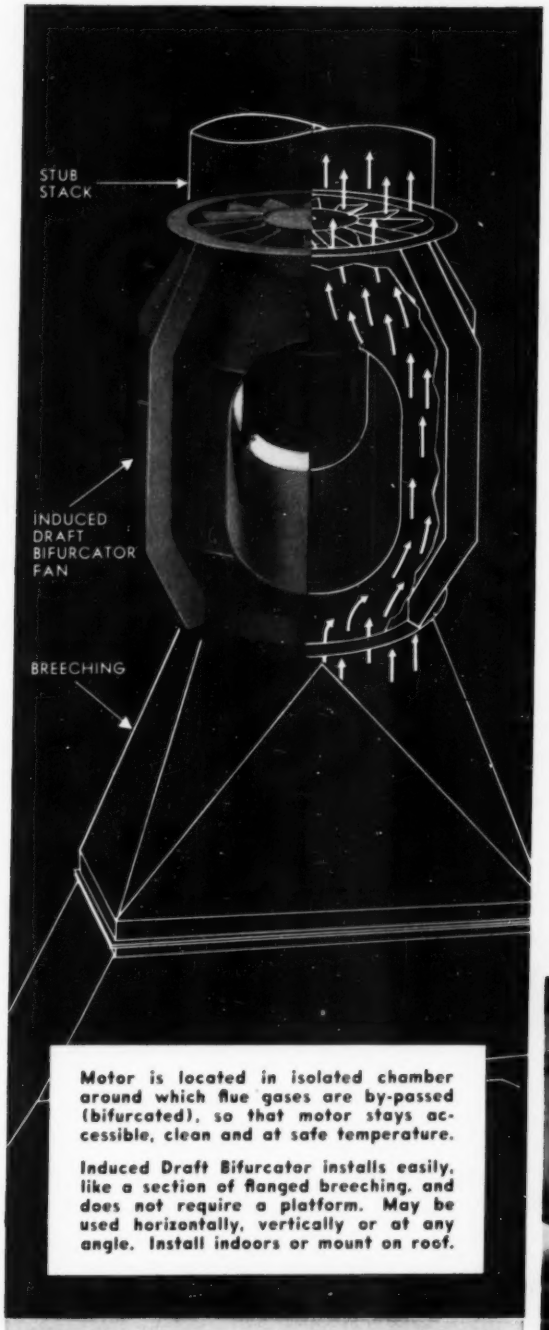
	Man-hours	
	Total	*Per 100 ft.*
a. Cleaning, rust removal, excavating under fence, placing tarpaulin	14	4.33
b. Painting, mixing paint, cleaning up	21	6.5
	35	10.83

Man-hours (total)

With 2 men with roller coaters 12
Additional time required by spray method finish-up job 5
Total thinned paint required ..... 14 gallons
Paint 10 gallons, thinner 4 gallons, for 324 ft. or 23.1 lineal feet per gallon.

4. Advantages over brush method (18 in. painters brushes)
   a. Rollers lighter, less tiring, more production.
   b. Rollers cover 2.5 more lineal feet per gallon than brushes.
   c. Rollers waste less paint by dripping, etc.
   d. Rollers coat barbed wire, railing, etc., better.
5. Cost of roller coaters equipped with long handles, about $3.98 each, replacement covers $2.50 each. No wear was noticeable on rollers after 324 feet.

I hope this answers your questions — *L. G. Jones, Dayton, Ohio.*



Motor is located in isolated chamber around which flue gases are by-passed (bifurcated), so that motor stays accessible, clean and at safe temperature.

Induced Draft Bifurcator installs easily, like a section of flanged breeching, and does not require a platform. May be used horizontally, vertically or at any angle. Install indoors or mount on roof.

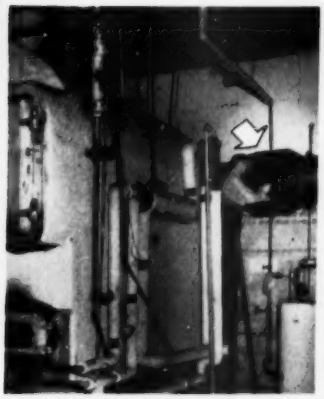
ELIMINATE TALL STACK...SAVE on COST and MAINTENANCE

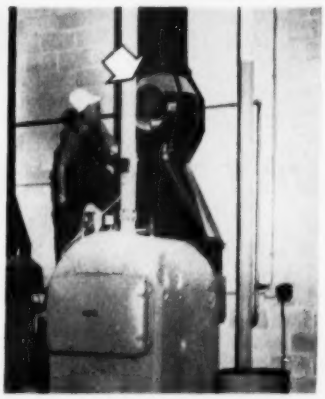
BIFURCATOR FAN

provides controlled boiler draft

The Induced Draft Bifurcator Fan provides controlled draft for boilers and furnaces under all weather conditions, and yet costs only a fraction as much as a tall stack. An Induced Draft Bifurcator Fan also solves the draft problem when you have no room for a tall stack or object to its unsightly appearance.

Bifurcators provide adequate draft for high-pressure boilers delivering up to 60,000 pounds of steam per hour and for low-pressure boilers rated up to 190,000 EDR. For specifications and construction details, use the handy coupon to request free Bulletin DB-32-53.





DeBothezat Fans

Division of American Machine and Metals, Inc.

EAST MOLINE, ILLINOIS

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Division of American Machine and Metals, Inc.
East Moline, Illinois

Please send me free Bulletin DB-32-53 containing data on Induced Draft Bifurcators.

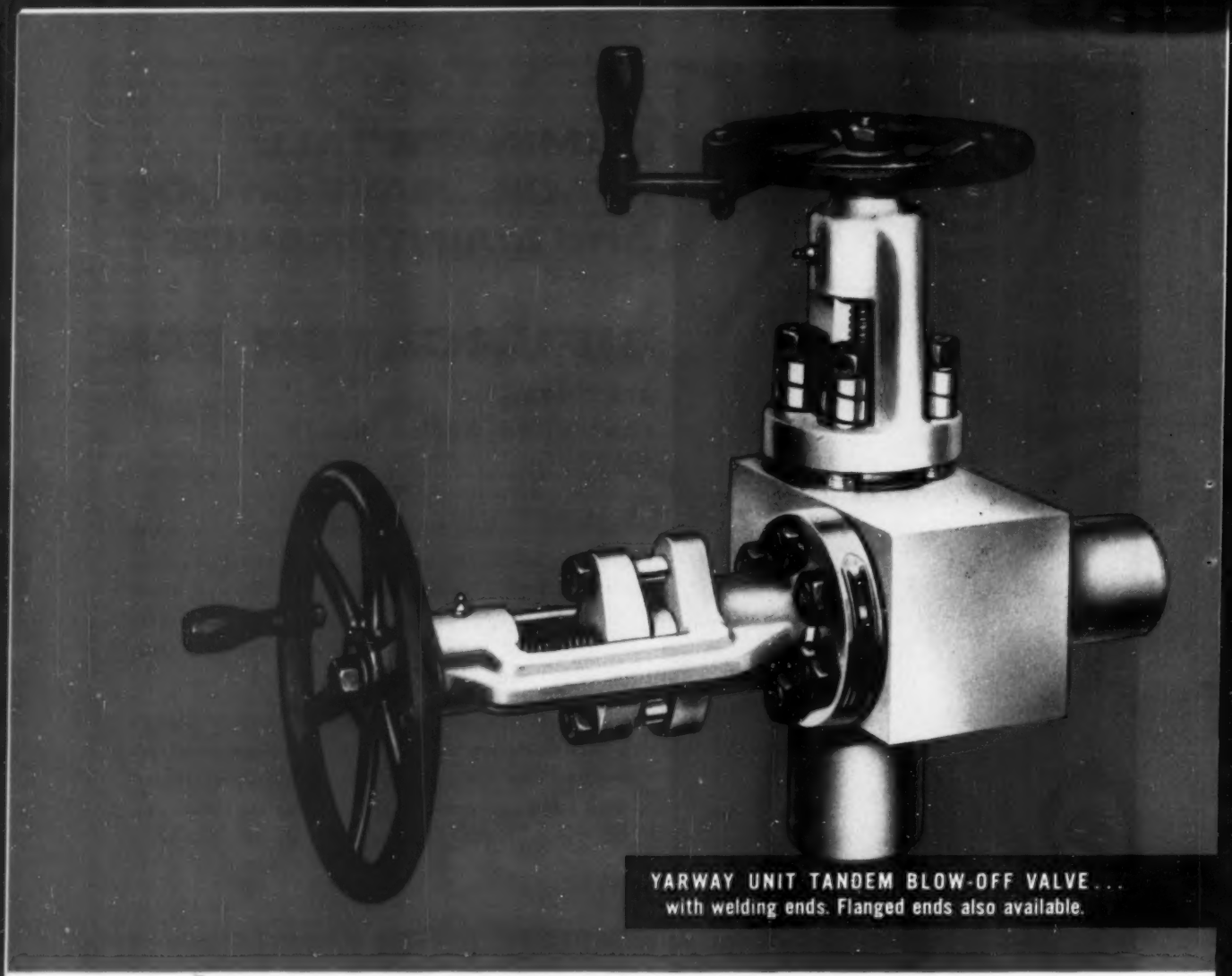
FIRM NAME

STREET ADDRESS

CITY ZONE STATE

ATTENTION OF MR.

For more data circle 504 on Post Card



YARWAY UNIT TANDEM BLOW-OFF VALVE...
with welding ends. Flanged ends also available.

BUILT TO "TAKE IT" AT

HIGH PRESSURES

As boiler pressures go up... so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

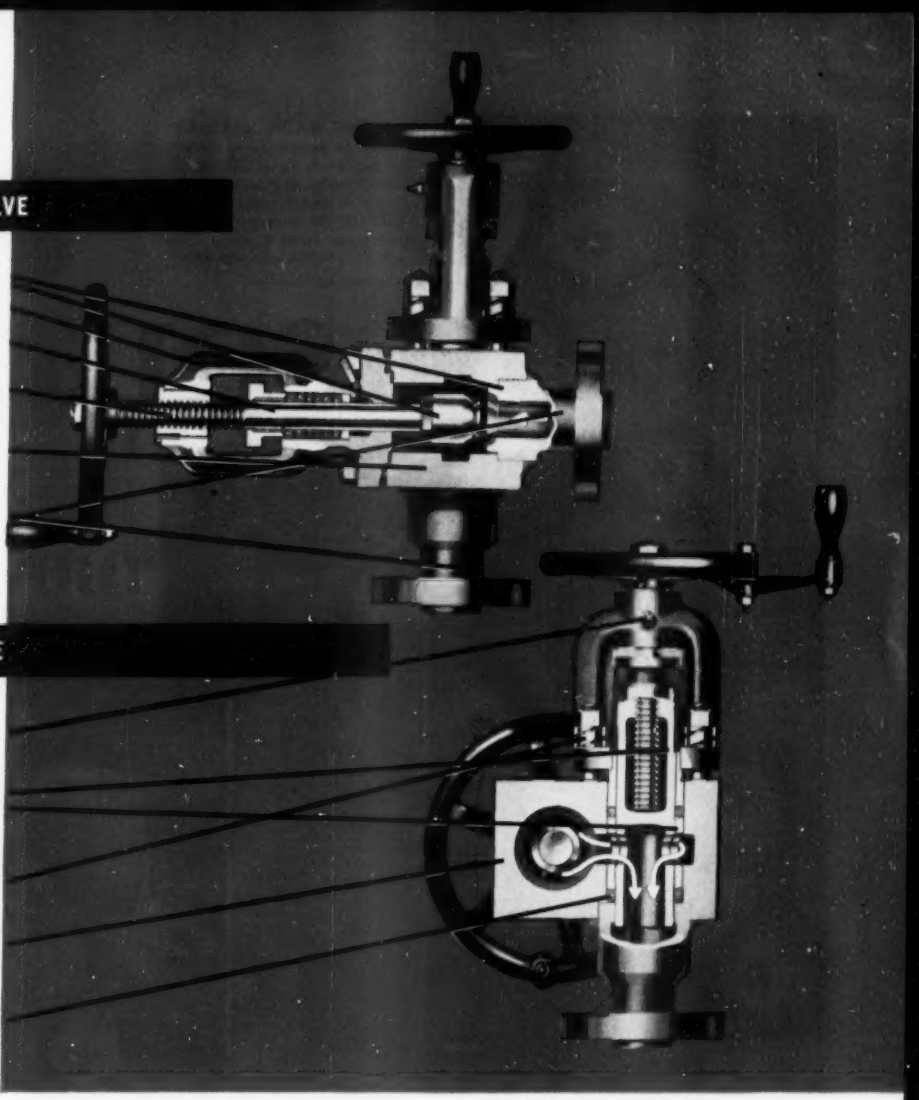
Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS

UTILITIES

Pennsylvania Electric Company
Pacific Gas and Electric Company
Dallas Power and Light Company
Boston Edison Company
Cleveland Electric Illum. Co.



HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

SEATLESS (Sealing) VALVE

Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.

Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

YARNALL-WARING COMPANY

114 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® blow-off valves

INDUSTRIAL PLANTS

Toledo Edison Company
Georgia Power Company
Union Electric Co. of Missouri
Rochester Gas and Electric Co.
Indianapolis Power and Light Co.

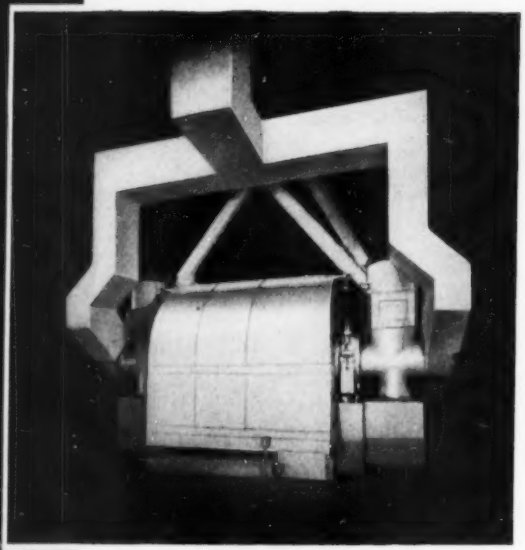
Bethlehem Steel Company
Ford Motor Company
Weyerhaeuser Timber Co.
Anheuser Busch Company
Procter & Gamble Company

Southern Kraft Corporation
Chrysler Corporation
Container Corp. of America
Eastman Kodak Company
American Viscose Company

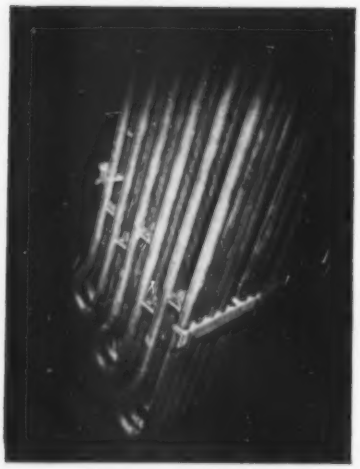
One source

... meets

STEAM GENERATORS for every central station or industrial use, designed, engineered and built to meet your needs for the economies of higher temperatures and pressures over central ranges not previously obtainable.

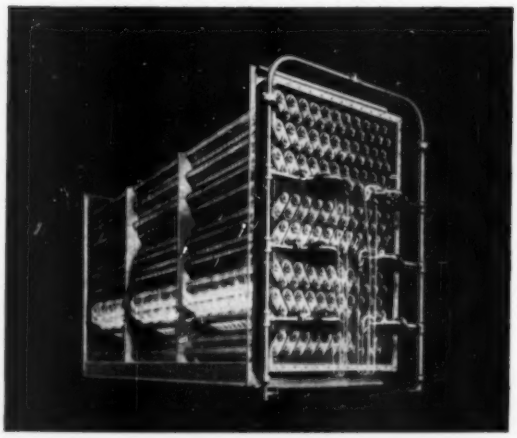


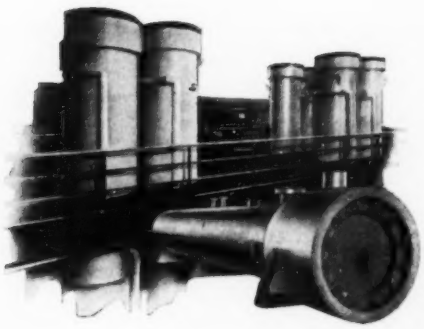
BALL MILL PULVERIZERS which grind hard, abrasive fuels to a constant fineness. Operating records show low maintenance, high availability of 99% or better.



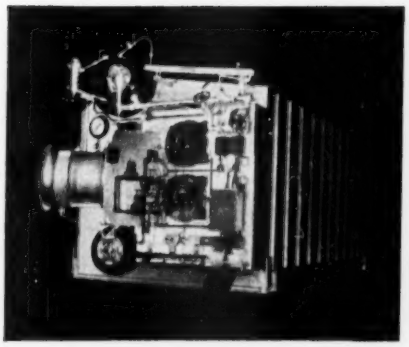
SUPERHEATERS of the convection and radiant type, either singly or in combination. Superheat control over a wide load range is also offered as a means of positive and accurate control of final temperature.

ECONOMIZERS of the cast-iron, extended-surface steel-tube type which are corrosion-resistant, impervious to soot fires, easily cleaned, and of unique, simple design. Bare tube construction also available.





PACKAGE STEAM GENERATORS in capacities of 10,000 to 30,000 lb. of steam per hr. Water-tube type, plant assembled, shipped ready to install. Design pressures of 250, 525, 825 psig provide operating pressures from 100 to 800 psig.



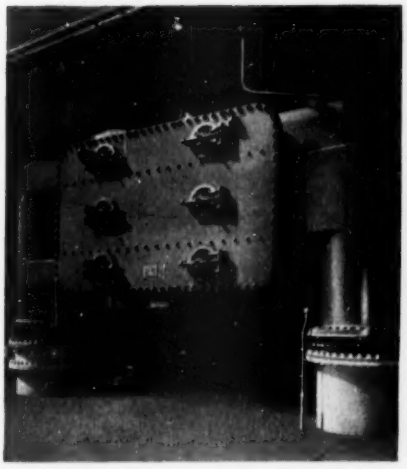
FEEDWATER HEATERS of the shell-and-tube type, as well as direct contact arrangements, are available. "Lockhead" closures have been built for pressures up to 3500 psi.

many of your steam plant needs

Only Foster Wheeler offers such a broad line of steam plant equipment engineered for increased efficiency through modernization.

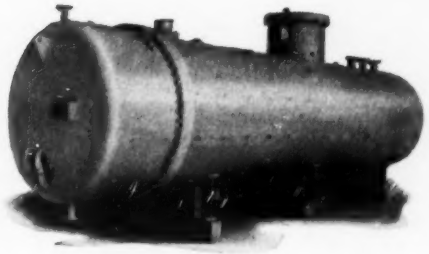
IN OVER 50 YEARS of service to the power industry, Foster Wheeler has pioneered the development of steam generators, fuel systems, condensers and cooling systems of the highest efficiency. Continuous research and engineering have created a background of technical experience, *as well as* an integrated line of equipment in which each individual product is designed to contribute to the efficiency of all.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



CONDENSERS to meet any conditions of headroom at any location. Our shops are fully equipped to supply units of 100,000 sq. ft. and larger.

EVAPORATORS for boiler feed make-up and of heat-transformer types in all sizes. Special types to handle raw and treated make-up to give the best thermal and descaling operation as well as producing pure vapor.



COOLING TOWERS custom-engineered to meet your requirements for greatest economy. Mechanical draft, counter-flow type. Provide minimum spray loss, flexibility to meet all weather conditions.

FOSTER WHEELER

For more data circle 506 on Post Card

BUILT FOR TODAY AND TOMORROW Located in the heart of a growing industrial and residential area, this central station has installed an "expandable" S-A conveying system. A good example of how S-A engineering can plan for changing needs, it is designed for lowest cost coal handling now and for continued economical operation when expanded to handle three times the present 200 tons per hour. Handling costs will stay low at all volumes!

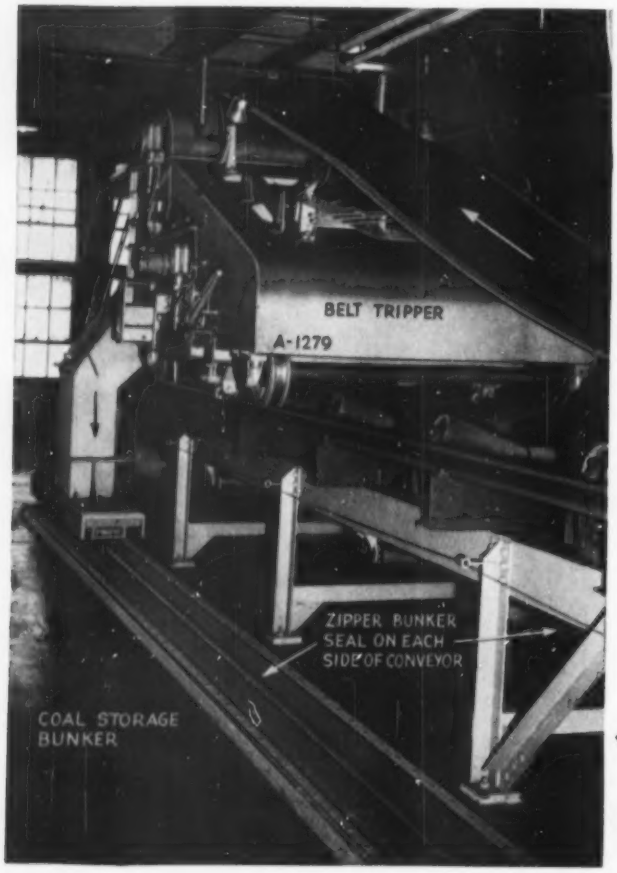
Engineered Conveying Systems REDUCE COAL HANDLING COSTS

The Stephens-Adamson coal conveying systems shown here, while different in components, design and layout, have one characteristic in common. They were all engineered to individual plant needs —to insure coal handling at low cost per ton. This economy is reflected in lower steam costs.

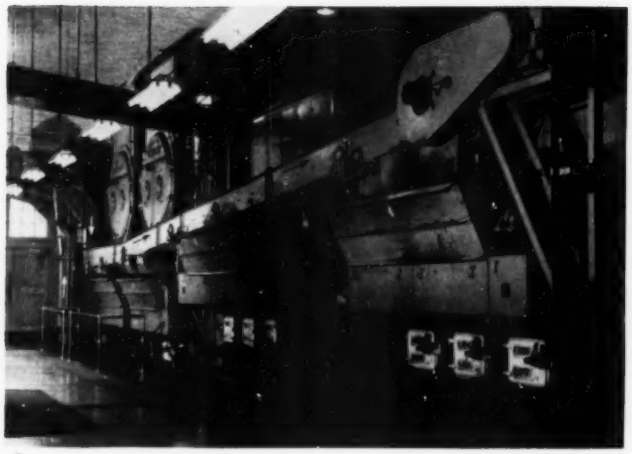
"Tailoring" to particular requirements is comparatively simple for S-A engineers. They draw upon a complete line that includes every kind of equipment for handling coal. They are backed by over half a century of experience in solving literally hundreds of different coal handling problems.

This combination of complete equipment, plus the detailed experience and "know-how", can be invaluable when improvement and modernization of your coal handling facilities is under consideration.

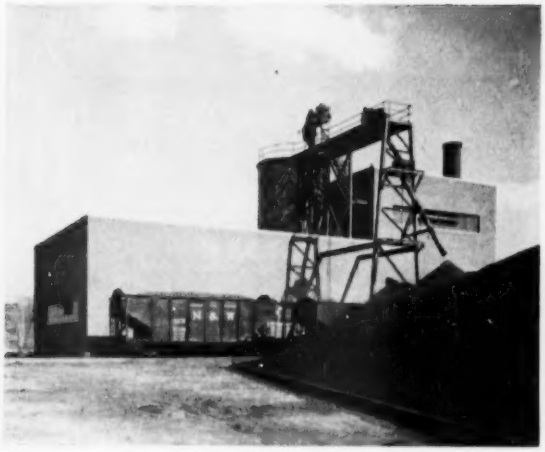
Write and we'll arrange a free survey—without obligation, of course.



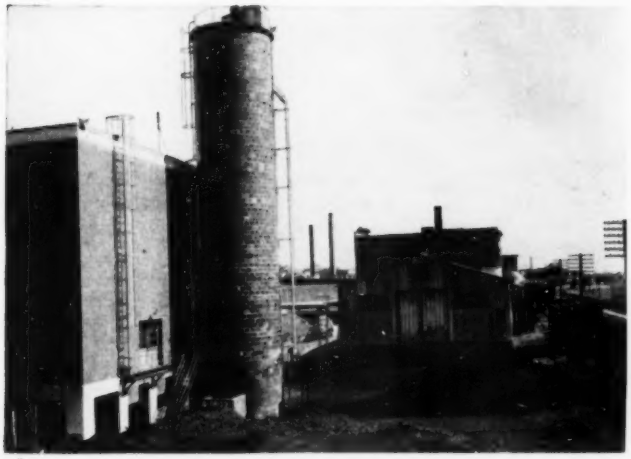
COAL ZIPPED-IN S-A patented Zipper bunker seal and belt tripper is part of new S-A coal handling system recently installed at a central station in Ohio. The seal consists of two strips of rubber with meshing teeth opened or closed by rollers mounted on the discharge spouts of tripper. Works like a slide fastener and keeps dust to a minimum inside the station.



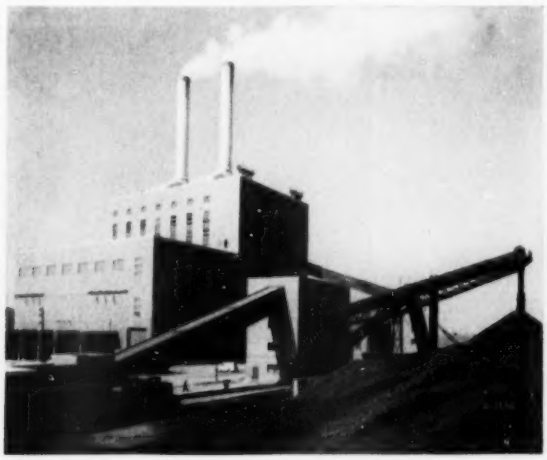
LESS LABOR COST — AND NO DUST Automatic, dustless coal handling made possible by S-A REDLER Conveyors is playing a major role in cutting weekly labor costs from $606 to $242 for this Maine textile mill. That amounts to a saving of $19,000 per year. REDLER units also have provided the layout flexibility required to meet difficult location problems existing in the plant.



EFFICIENT HANDLING IN SMALL SPACE This S-A REDLER conveying system at a municipal station in Virginia, moves 30 tons of coal per hour to either live storage above stokers or to outside stock pile. The system illustrates S-A design and use of REDLER units to save space, seal in coal dust and operate with minimum maintenance. From track side to stokers, S-A conveying systems can be engineered for any coal handling or distribution job.



SAVES $90,000 A YEAR Modernization of power plant with new boilers and controls and the installation of an engineered S-A conveying system for coal has enabled this North Carolina bleachery and finishing works to slash operating costs. Storage silo at left is filled by S-A REDLER Conveyor. Another REDLER carries coal to stoker hopper—without dust or high maintenance costs—while S-A Swivel piler stock piles overflow from silo.



750 TONS PER HOUR That's the capacity of the S-A belt conveying system at this Great Lakes station. Efficient arrangement of coal handling system which S-A engineers helped design permits coal stockpiling when bunkers in plant are full. Stocking-out conveyor at right is equipped with a motor controlled, telescoping spout. A similar plant operated by the same company is also S-A equipped.

SINCE 1901 S-A STEPHENS ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

86 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

Engineering Division

Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division

A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

SealMaster Division

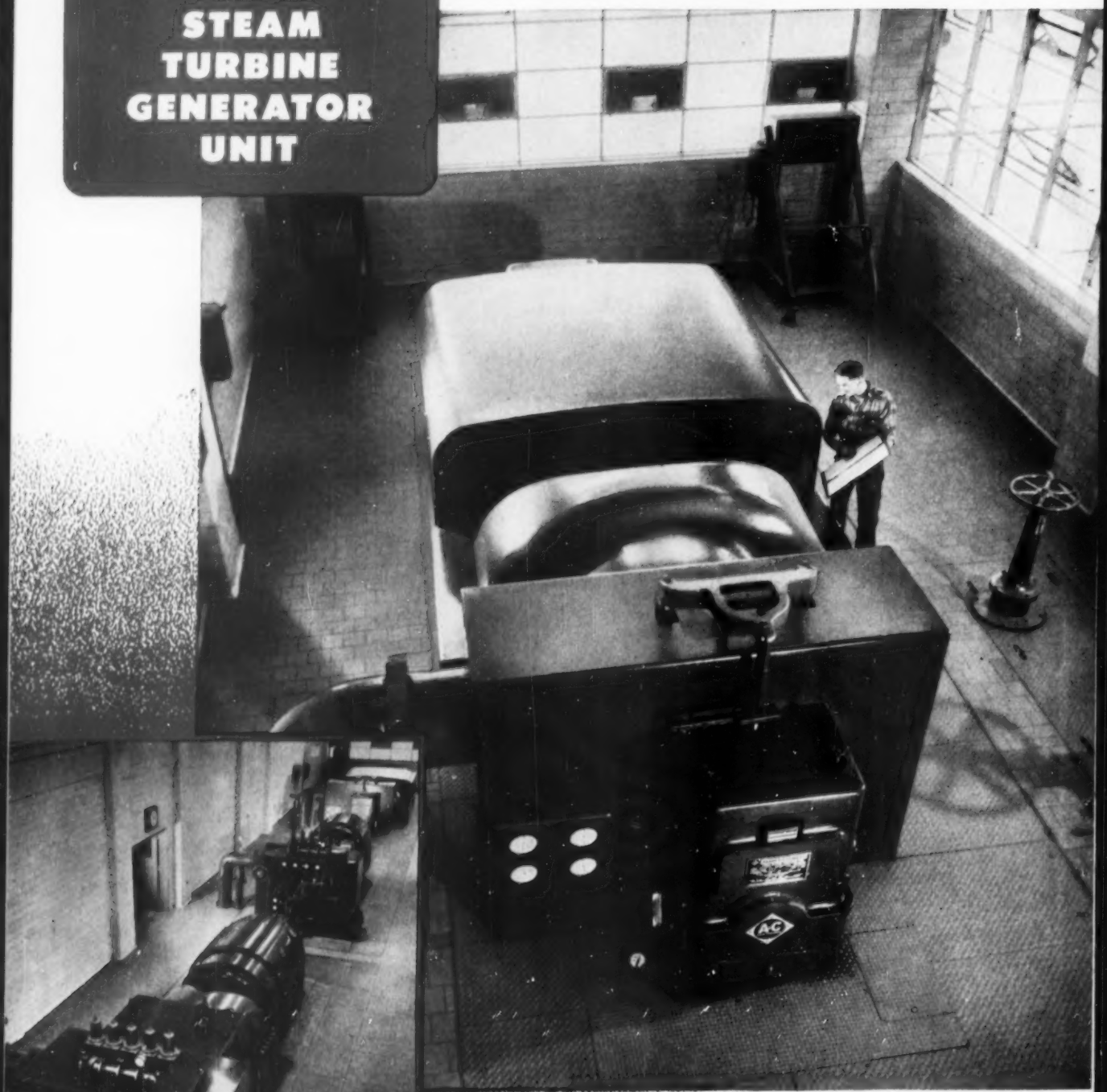
A complete line of industrial ball bearing units available in both standard and special housings.

For more data circle 507 on Post Card

Steam

WA-Series

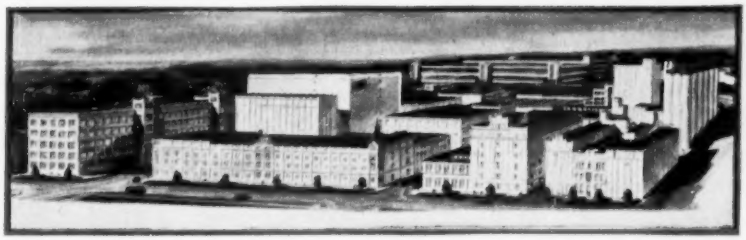
STEAM TURBINE GENERATOR UNIT



ALLIS-

Works Twice

FOR WORLD-FAMOUS BREWER



Jos. Schlitz
Brewing Company
Uses Steam for Both Processing
and Power Generation

Great quantities of steam are required for production of the "beer that made Milwaukee famous" at a rate exceeding six million barrels of beer a year. With so much steam needed for process, the electric power needed for plant operation is generated as a by-product.

At the Schlitz home plant in Milwaukee, two Allis-Chalmers 2500-kw, automatic extraction condensing turbine-generator units have been supplying process steam and electric power for the past five years. Recently, when more generating capacity was needed to match rapid plant expansion, Schlitz again turned to Allis-Chalmers.

Now operating 24 hours a day, 7 days a week, the new 5000-kw turbine-generator shown here was installed in the space originally planned for a third 2500-kw unit. It consists of a condensing, automatic extraction, impulse turbine and a housing type, air-cooled generator and exciter all carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA standard ratings 2000 kw and larger, the modern WA-Series unit is designed to meet modern power plant requirements. Bulletin 03B7654 gives complete details. For your copy, just call your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4269

WA-Series Features

For easy installation and maintenance, every detail of the unit is designed for maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit that simplifies foundation requirements. Shipment of the turbine and the generator with their rotors in place further minimizes installation time.

Maximum reliability is assured by labyrinth spring-backed steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

CHALMERS

A-C ALLIS-CHALMERS

For more data circle 508 on Post Card

Controlling Costs Automatically

Republic Automatic Combustion Controls Offer All Types of Boiler Plants Three Ways to Save

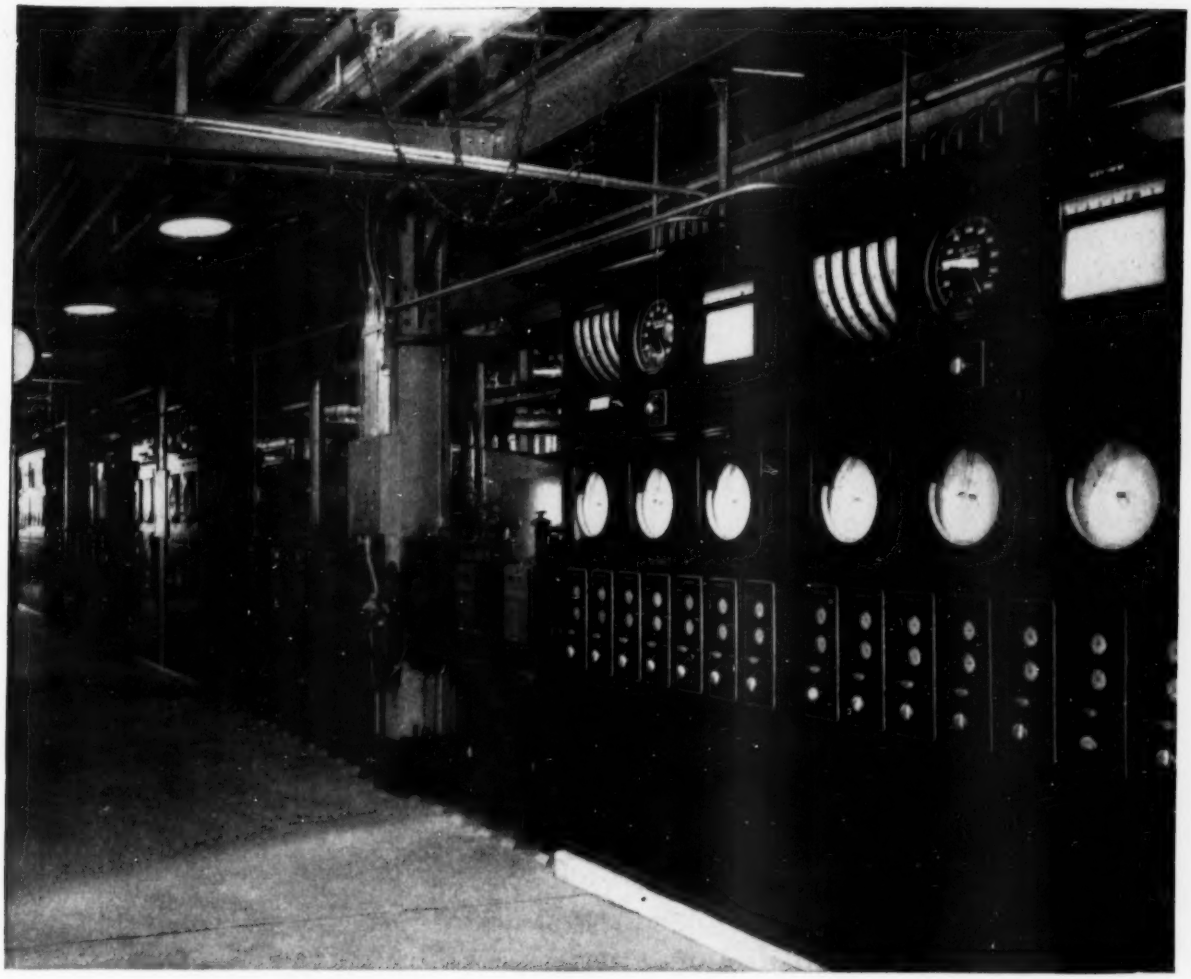
AUTOMATIC combustion controls are looked upon primarily as fuel savers. That's their most important advantage, but their effect on maintenance and equipment costs should not be overlooked, either.

For example, Republic Automatic Combustion Controls hold operating conditions uniform to prevent chain-of-event troubles and high maintenance costs that result from incorrect boiler operation. Republic controls, themselves, are ruggedly built to give years of dependable service.

Also consider the cost of stand-by equipment that must be purchased because boilers can't be continuously operated manually to produce the maximum steam output they are capable of generating. Human efficiency just isn't that good. Boilers operated by Republic Automatic Combustion Controls, however, perform at maximum efficiency, 24 hours a day, 7 days a week . . . at all loads. Expensive excess boiler capacity is not necessary to meet "peak" loads.

Republic Automatic Combustion Controls are used in all sizes and types of boilers, in central stations and in small industrial steam plants. Whatever the size or type of your boiler, the type of fuel burned or the load conditions, we can help you control costs by automatically controlling combustion. Write for complete details or contact your nearby Republic field engineer.

REPUBLIC FLOW METERS CO.



Republic Automatic Combustion Controls

At Carter Oil Company • Billings, Montana

The boiler plant for Carter Oil Company's modern refinery at Billings, Montana is operated for maximum efficiency by a complete Republic control system for combustion, feed-water and desuperheating. Automatic combustion controls are coordinated with feedwater and desuperheater controls to enable the boilers to meet all load changes smoothly.

The plant consists of four boilers, each rated at 42,000 pounds of steam per hour. Total steaming rates average 125,000 pounds per hour. The boilers are gas fired with oil as standby. Both fuels may be fired simultaneously, if desired.

Looking down the firing aisle of the Billings refinery in the photograph above, Republic control panels for the boilers are at right. Located at the left of each panel are Republic regulators which send control impulses to positioners of fuel valves and fans. Feedwater regulators are also located with the combustion regulators.

2240 Diversey Pkwy., Chicago 47, Illinois

For more data circle 509 on Post Card

...invisible values

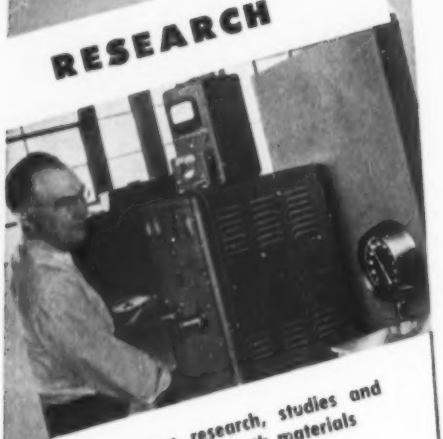
Separate an Ashcroft Gauge into its component parts and many of the reasons that have made it the leader for over a century remain unseen. For they are invisible values . . . equally as important to the sustained high accuracy and long-life endurance of the gauge as the Bourdon Tube, the movement, linkage, case and other components.

Creative research, highly functional design, quality control of both materials and methods and rigid manufacturing standards are "built into" every Ashcroft Gauge . . . are the fundamental reasons why high performance standards are expected and attained in every gauge bearing the Ashcroft Shield.

The new Ashcroft Gauge Catalog 300 is now available. Write for a copy.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is thoroughly acquainted with the various lines of Ashcroft Gauges. You can depend on him to help you in selecting the right type for your particular needs—and to deliver promptly.

RESEARCH



Continuous research, studies and tests guarantee both materials and methods.

Completed designs as well as individual components are subjected to "breakdown" tests in the Research Laboratory pictured here. These tests subject all materials and methods to vigorous analyses . . . are designed to keep Ashcroft ahead of future as well as current gauge requirements regardless of industry demands.

ASHCROFT GAUGES

of ASHCROFT GAUGES

1850 ASHCROFT U.S.A.

DESIGN

Sustained accuracy is the major objective of the design function.

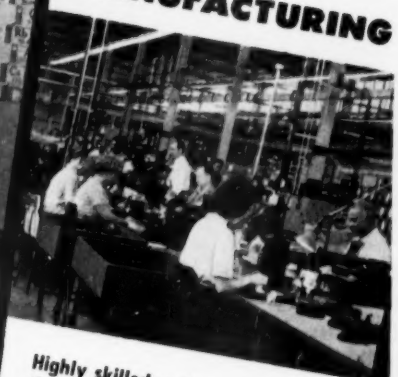
Where research largely determines materials and methods to be used, the design function is primarily concerned with sustained high accuracy. The drafting room shown above is one of the most essential "creative centers" in the progress of an Ashcroft Gauge from original research to finished product.

QUALITY CONTROL

Ashcroft metallurgists subject all raw materials and parts to thorough examination and tests.

Augmenting research and design, quality control exhaustively examines, for functional surety, all materials used in the gauge as well as the finished product. No substitute for final inspection, quality control "guards the gauge" from original design to final manufacture.

MANUFACTURING



Highly skilled craftsmen command the most modern equipment and plant facilities to assure manufacturing excellence.

This unbeatable combination produces the Ashcroft Gauge . . . an achievement in metal . . . first conceived by Ashcroft research and design engineers and completed by unmatched production techniques. Pictured is one of the assembly sections where perfection of gauge performance is considered a manufacturing challenge as well as a responsibility.

1850 ASHCROFT U.S.A.

A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

MANNING MAXWELL & MOORE INC. TRADE MARK

For more data circle 510 on Post Card

OBEY THE LAW
and pocket the difference

TAYLOR STOKERS are operating today in the heart of some of the finest urban areas... meeting ironclad stack discharge ordinances without expensive fly ash collectors and resultant draft losses... yet burning whatever types of coal cost least in each particular locality.

MATCHLESS EFFICIENCY

Smokeless operation and outstanding economy ...higher average CO_2, minimum solids in stack gases... these are outstanding characteristics of engineered Taylor Stokers.

UP TO 500,000 LBS.

Whether you require 20,000 or 500,000 lbs. of steam per hour, ask your Consulting Engineer about Taylor, the completely modern stoker with the old, old name... write for descriptive literature. American Engineering Company, 2408 Aramingo Ave., Philadelphia 25, Pa.

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PA.
IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD. MONTREAL 2, P. Q.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

For more data circle 511 on Post Card

"You see POWELL VALVES everywhere!"

Not surprising when you realize that Powell makes more kinds of valves and has probably solved more valve problems than any other organization in the world. And this has been going on since 1846.

Wherever flow requires dependable control, there's the place for Powell Valves—available through distributors in principal cities. Made ⅛" to 30" and 125 pounds to 2500 pounds W. S. P. Bronze, iron, steel and corrosion resistant alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves

108th year

For more data circle 512 on Post Card

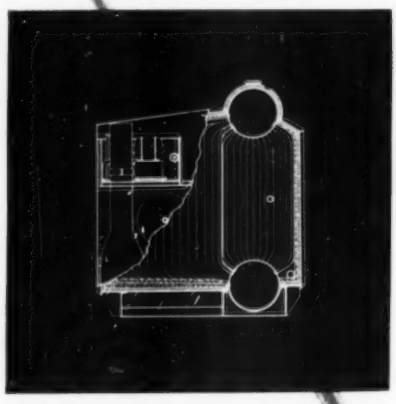
Which C-E Boiler meets YOUR steam needs best?

These four C-E Boilers have been specifically designed to meet the requirements of a wide variety of plants. Collectively, they offer you a range of capacities from 4,000 to 350,000 pounds of steam per hour... pressures up to 1375 psi... temperatures to 960 F... arrangements for any fuel or method of firing.

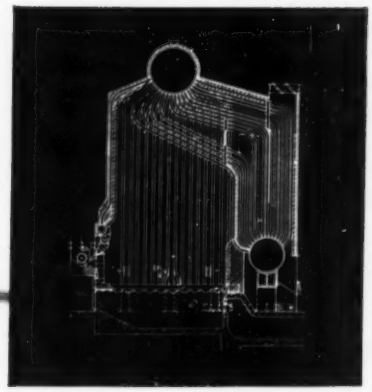
Two of these units, the VP and the VU-10, are fully standardized. Each of the other two has been standardized as far as is practical for its particular field of application. Thus, all four units reflect in purchase price minimum engineering costs made possible by maximum design standardization.

It's small wonder, then, that industries of all kinds have demonstrated widespread acceptance of C-E Industrial Boilers. The low steam costs and top reliability of these Combustion Boilers can be your guide, too, to the maximum return on your new boiler investment. B-703

C-E Package Boiler — Type VP The VP Boiler is designed to meet the demand for compact, standardized units in the medium pressure range. It is shipped completely shop-assembled, with firing equipment, fittings, and forced-draft fan. It is enclosed in a reinforced, welded steel, gas-tight casing. Arranged for pressure firing of oil or gas, the VP will burn either fuel exclusively or alternately. Designed for shipment by rail or truck, its width and height remain constant... variations are made in length only. Furnace is fully water-cooled, including burner wall, except in three smallest sizes. Large lower drum permits simple, symmetrical tube arrangement and greater water storage capacity.

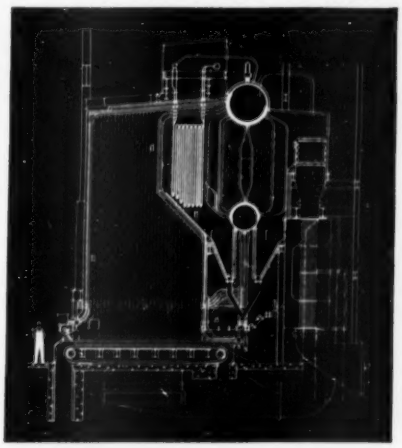


Type VP Boiler — from 4,000 to 30,000 lb steam per hr... pressure to 250 psi... available for either gas or oil firing... fully shop-assembled.



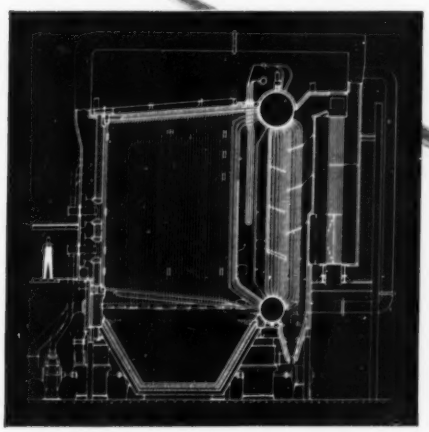
C-E Vertical-Unit Boiler — Type VU-10 Like the Type VP Package Boiler, the VU-10 is designed for plants having a limited number of operating and maintenance personnel. It is designed for industrial load conditions and will operate efficiently over a wide range of output. The boiler is bottom supported and has no outside supporting steel. The same general cross-section arrangement of drums, boiler convection bank, and furnace wall cooling is used when firing oil, gas or coal. Coal firing may be with underfeed, spreader, or chain grate stokers.

Type VU-10 Boiler — From 10,000 to 60,000 lb steam per hr . . . pressure to 475 psi . . . superheat to 200 F . . . suitable for any type of fuel.



C-E Vertical-Unit Boiler — Type VU-40 The VU-40 Boiler is a baffleless boiler designed for use with fuels having abrasive qualities in the flue dust. In a baffled boiler using these abrasive fuels, erosion is apt to occur. In the VU-40 Type Boiler, the eroding action of abrasives against boiler tubes and refractory is virtually eliminated. Like the VU-10 and VU-50, this unit is of symmetrical design, providing uniform gas flow and heat absorption across the full width of the boiler.

Type VU-40 Boiler — from 60,000 lb steam per hr up . . . pressure to 1375 psi . . . temperature to 960 F . . . for use with abrasive or high ash content fuel . . . indoor or outdoor type construction.



C-E Vertical-Unit Boiler — Type VU-50 With the VU-50 Boiler, the average plant can achieve standards of performance closely approaching those of large central power stations. The basic design was originated by Combustion in 1925 and has been widely accepted among steam-power engineers everywhere. Because of its symmetrical design the VU-50 provides uniformity of gas flow, water level and steam release across the full width of the unit. It may be fired by pulverized coal as shown opposite or by any other fuel or method of firing. Heat recovery equipment may be added.

Type VU-50 Boiler — from 60,000 to 350,000 lb steam per hr . . . pressure to 1375 psi . . . temperature to 960 F . . . for any fuel or method of firing . . . indoor or outdoor type construction.

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HELPFUL BULLETINS

ELECTRICAL EQUIPMENT

101 To Reduce System Investment — Bulletin GEA-5847, 24-pp, tells how to reduce system investment by distribution system planning and substation selection. Contains an analysis of distribution investments, a list of factors involved in determining optimum substation size, and a discussion of the types of circuits supplying distribution substations. Cites seven trends in low-cost system expansion. General Electric Co.

102 Distribution Transformers — Type SL, a large distribution transformer (250–500 kva) for increased load densities on distribution systems, is described in 8-pp Bulletin B-6134. Shows how construction and standardization allow economic handling and operation. Discusses choice of windings, method of tap changing outside tank, accessories. Westinghouse Electric Corp.

103 Motor Control Centers — Bulletin 170, 12 pp, defines these centers as a number of combination motor starters, each within a separate compartment, which is part of a panel section ready for installation. Diagram shows typical control center installation. Lists control unit dimensions and ratings, ordering information and data, other motor controls. Arrow-Hart & Hegeman Electric Co.

104 Metal-Clad Switchgear — Bulletin 7004B is a 24-pp booklet on company's Multumite horizontal drawout switchgear for switching, controls and protection of generators, motors, transformers, feeder circuits, incoming lines and tie circuits. Explains and illustrates important construction details, stressing circuit breaker design. Shows how the air circuit breaker protects through positive arc interruption, and is built for safe, easy handling. Includes check list covering what you should know to take advantage of basic standard assemblies. I-T-E Circuit Breaker Co.

105 Short Circuit in Harness — Amplidyne systems, how they operate, and where they can be used are described in 24-pp Bulletin GEA-4053. Includes multicolor cross-sections, circuit diagrams, charts, and photos. Electrical principles of the "short circuit that moves mountains" are explained step-by-step, and various applications of it are described and illustrated. General Electric Co.

Answers to a power engineer's operating and maintenance problems are often found in new commercial literature. To order bulletins, use postage-free Reader Service Cards on page 113.

106 Interrupter Switch — This 12-pp bulletin describes company's Type QB device in various positions of operation on different types of air switches. Shows views from movie films on arc interruptions; also shows results of an ice test. Table gives tentative interrupting ratings for air switch attachments. Delta-Star Electric Div., H. K. Porter Co., Inc.

107 Fuse Cutouts — Sixteen-pp Bulletin GEA-1816H describes open drop-out fuse cutouts for sectionalizing main feeders, switching transformers, capacitor banks, and other loads. Shows all ratings, explains how the open drop-out cutout clears fault current, and how the load-break fuseholder breaks load current. Also shown are unit-combination arrester and cutout, and separate and combination mountings. Applications of the cutouts are cited. General Electric Co.

108 Cartridge Fuses — Form S-60, 12 pp, describes and illustrates manufacturer's dual-element cartridge fuses designed for long and controlled blowing time. Lists benefits afforded by these fuses and gives data on both ferrule type and knife-blade type. Provides selector table covering sizes of fuses for protection of single-, two- and three-phase motors of ⅛ to 200 hp. Also includes time current curves on 250-v and 600-v fuses. Economy Fuse & Mfg. Co.

109 Mercury Switches — Catalog 90, 12 pp, gives standard designs of company's mercury switches for a-c or d-c switching applications that provide low force and tilt motion. Includes such classifications as protected, heavy duty, general use, small and sensitive switches. Gives dimensions, electrical rating, differential angle, lead wires, types of application, technical data. Micro Switch, Div., Minneapolis-Honeywell Regulator Co.

110 Simplified Cable — Eight-pp Bulletin RS-5 provides specifications, physical data and sag and tension data on triplex service drop and secondary cable, both copper and aluminum conductors, and with Neoprene or polyethylene insulation. Lists advantages of this cable, illustrates typical installation methods, and gives suggestions for overhead aluminum connections. Rome Cable Corp.

111 Push Buttons, Lights — Sixteen-pp Bulletin GEA-5779B presents company's line of oil-tight push buttons, indicating lights, selector switches and accessories. Shows how they work, where they can be used. Illustrations include dimension and outline diagrams, cross-section drawings and full color applications photos. General Electric Co.

112 Underground Duct Installation — Bulletin 54B, 8 pp, is a manual of recommended field practices for installing Oct-O-Duct, a non-metallic underground conduit for power and communication circuits. Illustrates methods for preparing trenches, erecting duct structures, manholes and encasing. Soapstone Duct Co.

MECHANICAL POWER TRANSMISSION

113 Speed Reducers — Besides covering a full line of worm gear speed reducers, 48-pp Catalog 1006 contains a section devoted to speed reducer selection, horsepower and torque calculations and service factors. Lists single-reduction and double-reduction worm gear types, worm gear screw conveyor drives and reducers, and gearmotors. Features company's new PoweRgear reducer designed to offer more horsepower per dollar. Fully illustrated, includes ratings, dimensions, prices. Eberhardt-Denver Co.

114 Adjustable V-Belt — This 8-pp catalog covers company's new Veelos TD and TE V-belt designed to reduce installation and operation costs on big drives. Studs, cup-washers and T-screws of the belt are illustrated in detail, and installation and operation characteristics are explained. Booklet includes directions on how to measure, to couple and uncouple, and to install. A table shows correct lengths for these belts, and illustrations show typical drives equipped with them. Manheim Mfg. & Belting Co.

115 High Capacity V-Belts — Bulletin 6628 describes manufacturer's Super-Power V-belts designed for greatly increased horsepower capacity, resistance to shock loads and length stability. Nine advantages are outlined. Also included is list of sizes and belt numbers applicable to the new belts. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

116 Electric Brakes, Clutches — Bulletin 6158 describes manufacturer's line of stationary field electric clutch-couplings and replaceable face electric brakes, designed for precise, automatic control of light machine instrument and servo drives. Lists specifications; discusses easy remote or automatic control, simple design, other advantages. Warner Electric Brake & Clutch Co.

PIPING AND VALVES

117 Steam-Jacketed Valves — Power engineers concerned with handling of viscous materials will be interested in Bulletin E-200 on steam jacketed valves. Explains how operating mechanism and special arrangement of steam jackets contribute to satisfactory service with a wide range of materials, including many which harden or congeal at atmospheric temperature. Illustrated with a large sectional view of the valve, photos of typical installations. Also includes dimensional table. Everlasting Valve Co.

118 Valve Installation Tips — Comprehensive instructions on proper way to install company's Line Blind valves are given in this pocket-size 24-pp manual. Concisely written, the booklet is illustrated with cartoon-type drawings. A separate section is devoted to trouble shooting for faulty-installation techniques along with

recommended corrective procedures. While dealing primarily with Line Blind valves, this information can be applied also to installation of gate, globe and plug valves. Hamer Oil Tool Co.

119 Light-weight Pipes — As a practical help to pipe users, Bulletin 507 shows typical applications of company's light-weight lockseam-spiralweld pipe and fittings. Includes standard specifications on pipe from 4 to 30 in. in dia.; also provides data on fabricated fittings, flanges and connections. Naylor Pipe Co.

. . . Outstanding Among This Month's Catalogs

120 Demineralizer Data — Twenty-pp Catalog 127 covers mixed-bed, two-bed, and four-bed demineralizers. Illustrated with photos, drawings and diagrams, the book explains principles, construction and operation of both mixed-bed and multi-bed types in capacities from 5 gph to 2500 gph. Gives dimensional and performance data on all models and explains difference between distilled and demineralized water, selection factors. Barnstead Still & Sterilizer Co.

121 Two-Metal Tubes — Sixteen-pp Technical Bulletin 1954 explains use of manufacturer's Duplex tubes for heat exchangers and condensers in industries and process plants handling corrosives. Tells how corrosion attacking inside and outside of tubes can be retarded with Duplex tubes, whose inner and outer walls are made of different metals — the outer metal selected to cope with the outside corrosion, and the inner metal to stand up under inside corrosive conditions. Bulletin discusses handling of products found in chemical processes, manufacturer of food and synthetic fibers, cooling of lubricating oils and other typical application of the Duplex tubes. Bridgeport Brass Co.

122 Pressure Gages, Accessories — An extremely comprehensive catalog on pressure gages, gage accessories and gage engineering information is the new 124-pp Catalog 300. Supplemented by photos, line drawings and dimensional drawings, the book is sectionalized by product lines and contains selector tables and indexes. Separate sections cover company's Duragauges, chemical gages, special industrial application gages, gage testers, mercury column pressure and vacuum gages, other types of gages, special gage features. Available to qualified power engineers. Please state your title when requesting this book. Manning, Maxwell & Moore, Inc.

123 Elevator Belting — This 24-pp illustrated engineering handbook on elevator belting describes types of belt and bucket elevators, gives factors for belt selection and outlines procedures for engineering correct belt. Data tables include weights of materials handled, holding properties of various fabrics, determining belt weight and thickness, drive factors. Includes suggested specifications form giving ordering information. Available to qualified power engineers, please give your title. The B. F. Goodrich Co.

INSTRUMENTS AND CONTROLS

124 Pneumatic Transmitter — Bulletin 2753 illustrates and describes a low-head type differential-pressure pneumatic transmitter designed particularly for measuring liquid fuels and automatic control of fuel-air ratio. Includes construction details and view of no-sealing-fluid measuring assembly, operating characteristics, and discussion of economy of air consumption, calibration simplicity. Hagan Corp.

125 Line Operated pH Meter — Bulletin 225 introduces a line operated pH meter priced to sell at around $115 and designed to bridge the gap between the more complex pH meters of earlier design and the comparison tests of limited accuracy. Stresses simplicity of operation and maintenance of the new direct-reading electronic meter, other advantages. Pictures instrument, shows meter scale. Photovolt Corp.

126 Bin Level Indicator — A handy reference manual for installation and maintenance use, Bulletin Form BD-5A, 20 pp, describes and illustrates company's pressure-actuated bin level indicators which show level of granular, pulverized and semi-liquid materials in tanks and silos. Lists advantages of low cost, easy installation, few maintenance requirements. Includes wiring diagrams, installation data for various types of units. Describes aerator unit for introducing low-pressure air into dry materials to restore fluidity. Bin-Dicator Co.

127 Snap-Around Ammeters — Pocket-sized snap-around volt-ammeters for a variety of jobs and budgets are shown in Amprobe Catalog 134. Includes high-voltage models for plant use, multi-range for higher current requirements. Describes Energizer, an accessory for quick current and voltage check at outlet, lists time and money-saving applications. Pyramid Instrument Corp.

128 Combustion Control Case History — An industrial boiler plant designed for high efficiency, future expansion, fuel flexibility and "good neighbor" performance is discussed in Bulletin R-9. Shows how combustion control equipment utilized enables easy switching of fuels. The Hays Corp.

129 Water Gage Television — Bulletin WG-1813 describes equipment for televising boiler water level gages, including TV camera, illuminator, monitor and linkage. Illustrates a suggested arrangement and lists suggested camera distances. Yarnall-Waring Co.

130 Telephone Signaling Device — This illustrated brochure tells how power engineers and others can be reached anywhere in the plant by means of a special signaling device which is part of an internal phone system. Automatic Electric Co.

131 Photoelectric Controls — A line of packaged, pre-engineered photoelectric controls are described as to features and application in 8-pp Catalog 53. Gives detailed information on general purpose, high speed, "fail safe," and ultra sensitive photoelectric controls, also controls with electronic timers and safety relays, light sources for the controls. Includes dimensions. The Autotron Co.

132 Dynamometer Systems — Bulletin GEA-5923, 12 pp, discusses dynamometer systems for testing internal combustion engines, transmissions, torque converters, pumps, electric motors. Tells how d-c dynamometer systems can be used for motoring and absorption applications. Gives data on system's wide speed and torque range capacity for meeting different testing and measuring needs. General Electric Co.

BOILERS, GENERATORS

133 Water Tube-Steam Generator — Bulletin SB-51, 16 pp, discusses features of Keystone two-drum water tube steam generator for delivery of low cost steam. Cites advantages of conservative boiler rating (full five sq ft of heating surface for each developed horsepower), automatic controls, easy installation, fast steaming qualities, compact size. Gives specifications on all materials furnished. Erie City Iron Works.

134 Boilers, Allied Equipment — Sixteen-pp Bulletin SB-50 is a condensed catalog describing and illustrating a line of steam generating equipment. Generous use of sectional views with concise text make this a handy reference for power engineers. Covers custom designed generators, high-capacity compact units, factory assembled units, waste heat boilers, steel heating boilers, other generators and auxiliary equipment. Erie City Iron Works.

PUMPS AND PUMPING

136 Centrifugal, Turbine Pumps — Eight-pp illustrated selection guide and index to company's current centrifugal and APCO turbine type pumps features color selection table showing how many gpm each type will deliver under various head capacities. Describes horizontal split case, and non-clog centrifugal types, also mixed flow pumps. Aurora Pump Co. Div., New York Air Brake Co.

It's easy to get these free catalogs—just circle item numbers of those wanted on the two post cards provided on pages 113-114

137 Chemical Pumps — This 24-pp brochure, Section 100, explains special designs of regenerative turbine pumps available for chemical services. Illustrates pumps, giving construction data, specification sheet, dimensions, performance tables. Contains detailed explanation of company's Net Positive Suction Head, with full data on use of this concept in selecting pumps. Includes survey and evaluation of a variety of mechanical seals available in turbine chemical pumps. Roy E. Roth Co.

HEATING

138 Self-Modulating Zone Heating — The SelecTemp heating system which permits individual thermostatic control of temperature in each area, is described in Form 2769, 8 pp. Explains operation of system components, independent operation of each heater unit, fuel savings, low installation cost, other advantages. Diagrams show examples of a central manifold system, two pipe and down feed systems. Iron Fireman Mfg. Co.

139 High Temp Water Systems — Sixteen-pp Bulletin 100 discusses and illustrates the application of high temperature high pressure water in distributing heat to

ARE CLOGGED LINES LIKE THESE CUTTING YOUR WATER SUPPLY?

Over 1½ Miles of Buried Water Line Chemically Cleaned IN PLACE by Dowell Service

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service used liquid solvents to clean all the lines, *in place*, during a period of only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective chemical cleaning of pipelines of all kinds—water lines, disposal lines and product lines. And, whether these lines are underground or above, indoors or out, no digging or dismantling is necessary. Dowell solvents are designed to dissolve the accumulated deposits, and are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water can flow, cleaning places inaccessible by other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job using Dowell-designed truck-mounted pumps, mixers and control equipment.

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FIND OUT ABOUT CHEMICAL CLEANING! There are many places in your plant where Dowell Service can clean equipment faster and better than out-dated mechanical methods. Call your nearest Dowell office for a fact-filled book. Or write direct to Tulsa, Dept. D-24.

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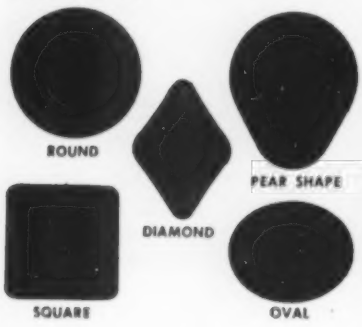
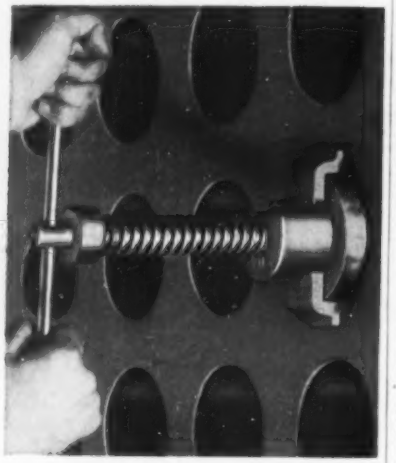
ROTO *Hand Hole* Seat Scraper

Eliminates Dirty, Tedious Work

Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.

These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.





Illustrating ease of operation of Roto Hand-hole Seat Scraper.

Roto Hand-hole Seat Scraper for B & W Boiler.

What Users Say—

It did a fine job. Completed the work in 80% less time.
(Engineer, Chemical Plant)

Roto Seat Scraper has paid for itself many times over on our Keeler Boiler.
(Supt., Public Utility)

One man cleaned inside cap seats on boiler header in 4 hours. Formerly took 2 men 3 days.
(Pennsylvania Manufacturer)

We also make a Reseating Machine for cleaning outside caps to assure a smooth, true fit. Send for details.

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large area installations, as district heating, industrial building groups, institutions. Presents several advantages offered by high temperature water heating. American Hydrotherm Corp.

140 Process Drying Case Histories — Now available to power engineers is a brochure of engineering case studies covering a variety of applications of warm air space heaters to industrial process drying. Tells methods followed in applying heaters to different types of drying systems, lists benefits derived. Studies are assembled in handy file folder. Dravo Corp.

141 Heat Transfer Equipment — Sixteen-pp Bulletin 1000 groups company's Paracoil heat exchanger products into chemical, industrial, power plant, and marine classifications. Includes 50 product illustrations, with full technical descriptions; also section on industrial fuel oil heaters. Davis Engineering Corp.

142 Fuel Oil Heaters — Sixteen-pp Bulletin 1415, on fuel oil heaters, describes two types: company's Twin-G-Fin section with longitudinally-finned heat transfer elements, and the Type B tubular heater. Explains design details of both types along with sectional views, installation photos, specifications and dimension tables. Also includes selection tables and capacity data. The Griscom-Russell Co.

143 Heating Pipelines — Eight-pp Bulletin GEA-5095A describes numerous pipeline applications of company's Calrod tubular heaters; tells how to calculate heating requirements. Comprehensive chart shows heat losses of vertical, solid, smooth surfaces of various metals. General Electric Co.

DUST CONTROL

144 Small Volume Collector — Bulletin 916, on company's Unit-Type CN cloth bag dust collector, tells how dust control of finely divided dry dusts can be provided for smaller volume applications at low equipment and installation costs. Tells how collector is designed for indoor use, permitting clean air to be discharged inside plant. Detailed descriptions of collector operation and cloth bag sealing mechanisms are presented. Also included are construction and assembly features, and table of dimensions, cloth area etc. Pangborn Corp.

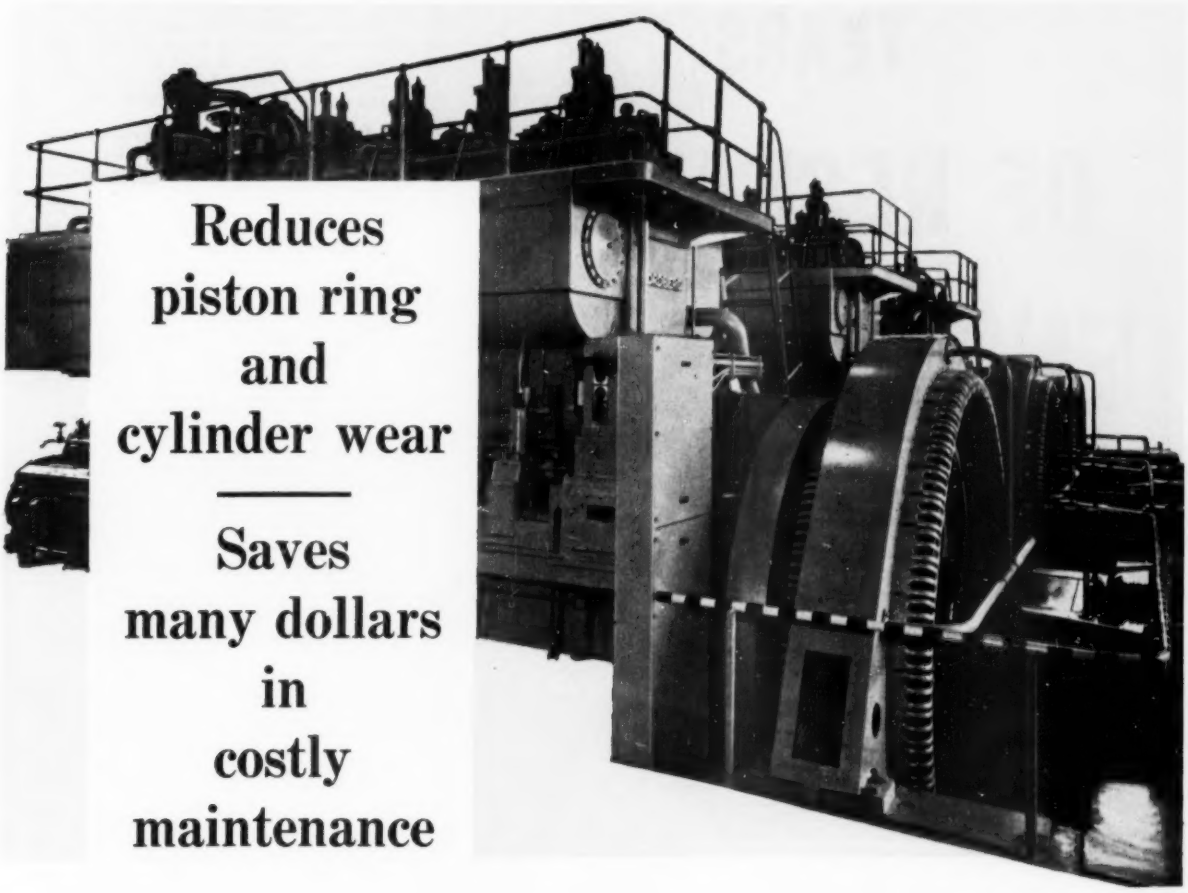
145 Stationary Vacuum Systems — Bulletin A-939, 12 pp, describes company's line of stationary vacuum cleaning equipment. Gives basic elements of system with central dust collection described in detail. Pictures coordinated accessories, auxiliary equipment, including portable separators, water traps, rotary discharge valves. Lists questions on data required for design of any plant cleaning system. U. S. Hoffman Machinery Corp.

DIESELS AND ACCESSORIES

146 Stationary Diesels — Bulletin 5303, 8 pp, describes five models of 9 to 54 bhp Lister stationary diesel engines, and one to six cylinders (3.75 by 4.5). Includes design features, specifications, dimensional diagrams. Engine Div., The National Supply Co.

147 Hose for Diesel Engines — Eight-pp Bulletin EH-50 gives descriptive and engineering data on flexible metal hose of diesel engine installations. Covers corrugated exhaust and air-intake hose, corrugated flexible metal diesel hose, inter-

Shell Rotella Oil



Reduces piston ring and cylinder wear

Saves many dollars in costly maintenance

These dual-fuel engines in the Municipal Power Plant at Houma, Louisiana, supply dependable, low-cost electric power to the entire city. Shell Rotella Oil is the cylinder lubricant.

Here's just one of the many diesel power plants that depend on SHELL ROTELLA OIL for reduced wear of engine parts . . . lower maintenance cost.

The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

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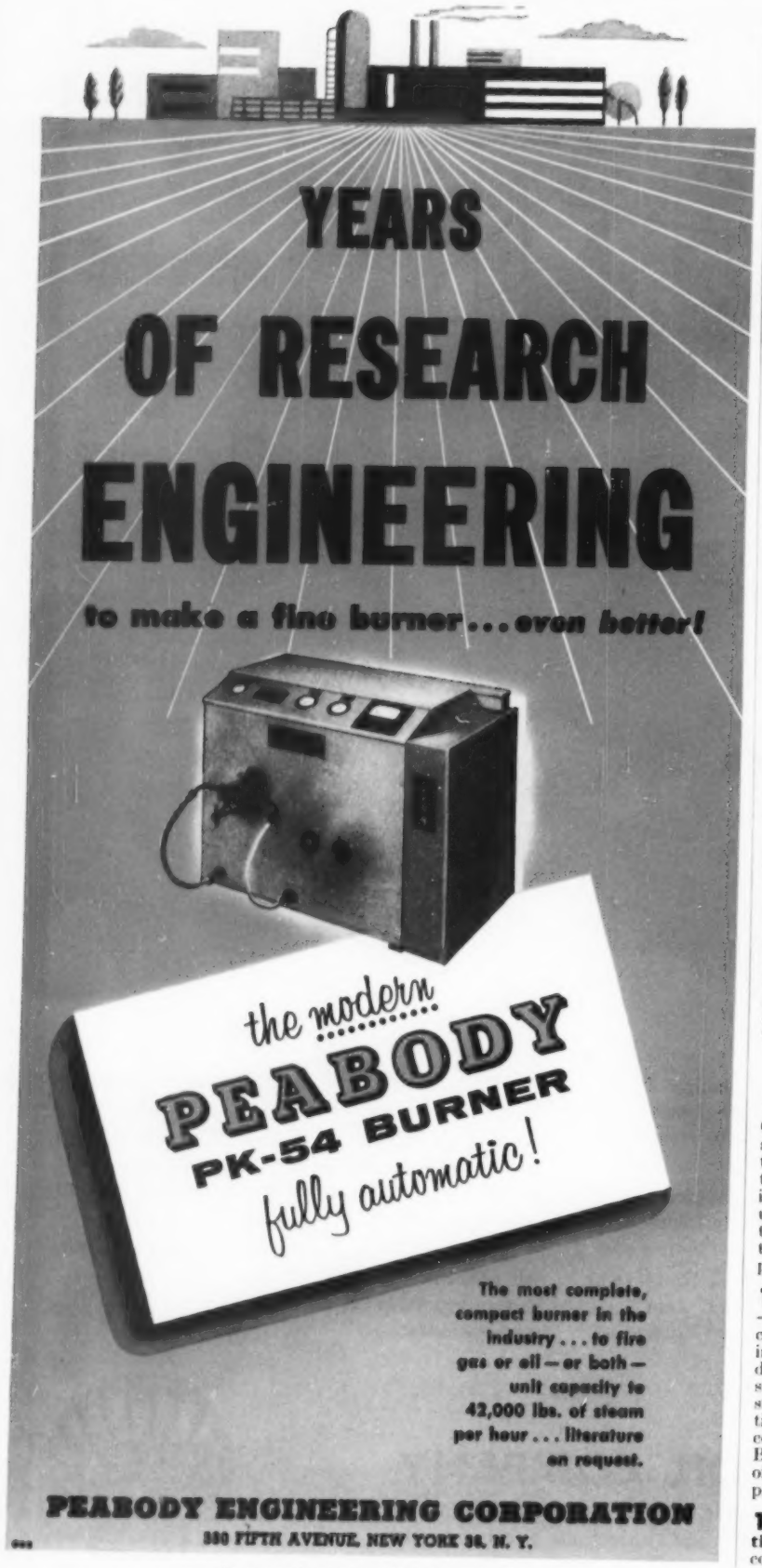
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The most complete, compact burner in the industry . . . to fire gas or oil — or both — unit capacity to 42,000 lbs. of steam per hour . . . literature on request.
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locked exhaust and air intake hose, and braid-covered seamless flexible tubing. The American Brass Co.

BUILDING CONSTRUCTION, MAINTENANCE

148 Floor Paving — Description and specifications on vitrified paving brick for safe, economical industrial floors is given in this 14-pp illustrated manual. Features procedures for laying floors, data on foundations and fillers in steel mills, chemical plants, areas where floors get continuous hard usage. Metropolitan Brick, Inc.

149 Safety Treads, Thresholds — Catalog 54, 12 pp, lists, gives dimensions of manufacturer's line of safety treads and metals in which they are available. Full size cross-sections are illustrated. Booklet also describes other Walkway products including saddles, sills, nosings and platforms. Wooster Products, Inc.

150 Rigid Insulation — Advantages and application information on Foamglas insulation for industrial and other buildings is presented in this 24-pp catalog. Well illustrated, gives condensed specifications for application in walls, ceilings, floors, roofs, perimeters, and in low temperature space insulation. Information on accessory materials is also provided. Physical properties, characteristics, and performance data on this cellular glass insulation are covered. Many installations are shown. Pittsburgh Corning Corp.

MATERIALS HANDLING

151 Elevator Buckets — Twelve-pp Catalog 100 illustrates and gives data and prices on a line of steel elevator buckets. Covers light- and heavy-gage models, shelf type buckets, continuous type buckets, super-capacity models. Includes information on punching of buckets for chain and belt elevators, capacity data. The Standard Metal Mfg. Co.

152 Tractors — Manufacturer's complete line of tractors and motor graders is pictorially described in 36-pp Bulletin MS-450-5310. Includes motor scrapers and wagons, expanded line of pull-type scrapers. Ten-pp section gives data on selection of equipment and attachments available. Tractor Div., Allis-Chalmers Mfg. Co.

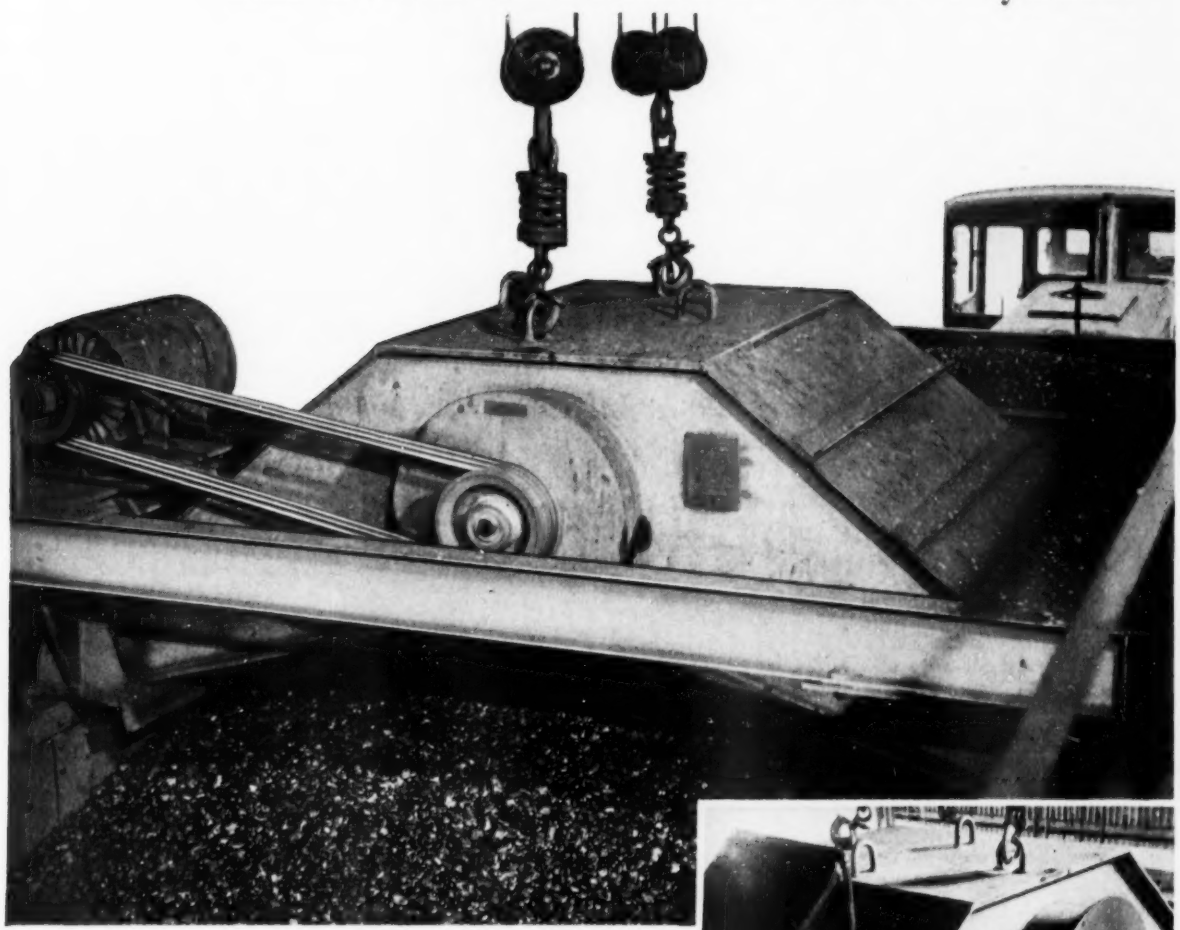
OTHER EQUIPMENT

153 Quick Mounting Brackets — Catalog 853, 8 pp, describes and illustrates a line of brackets for the support of cable trough, conduit and instrument tubing trough. Photos and dimensional drawings illustrate brief descriptive text on standard units. Also shown are some of many ways these brackets may be quickly assembled to provide support for a wide range of applications. The Rakit Corp.

154 Stainless in Paper Industries — This handsomely illustrated 36-pp book covers the use of company's stainless steel in the paper and pulp industries. Provides detailed information on the technology of stainless steel; also includes a stainless steel "finder" giving comparative properties of various grades, and a table showing corrosion resistance to various media. Booklet also gives an interesting account of the paper making industry and by-products. Allegheny Ludlum Steel Corp.

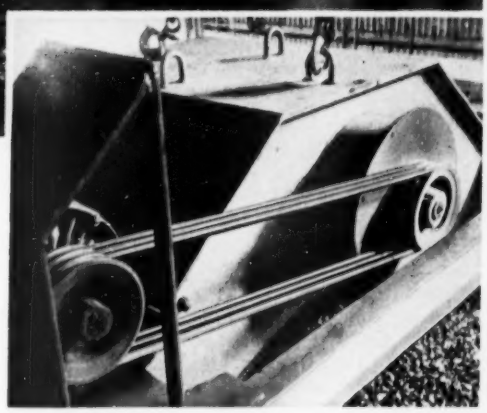
155 Air Conditioning-Refrigeration — Section M, Form W-2-S is a 12-pp condensed catalog furnishing up-to-date

U. S. Rubber V-Belts have been taking this shock treatment for over 3 years!



The V-Belts on this coal car shakeout must transmit the power to shake the car to loosen tons of packed or frozen coal. Yet this matched set of U. S. Royal® Super-Service V-Belts has been working steadily on this shakeout *for more than 3 years.* Three other brands of belts lasted an average of only 3 weeks. Moreover, the "U. S." belts withstood the extreme shock load...never jumped the pulleys.

Part of this success stems from the unique Equa-Tensil Cord Section built into U. S. V-Belts. This development makes certain each cord pulls its *full* share of the load. Order from your distributor, or get in touch with any of our 25 District Sales Offices, or write to address below.



Two views of drive of heavy-duty coal car shakeout. This shakeout handles over 30 cars a day, is equipped with a matched set of three C-144 super-service V-belts.

"U. S." Research perfects it
"U. S." Production builds it
U. S. Industry depends on it

US RUBBER

UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

For more data circle 519 on Po Ca d

No mud
No dust

NO CLEANUP TIME

*with G-B Snap*On Pipe Insulation!*

Insulating pipes is no longer a messy job that ruins the appearance of the plant — not when you use G-B Snap-On pipe insulation! This new one-piece pipe insulation of molded fine glass fibers is absolutely dustfree —won't crumble or flake when dry, won't get gummy or muddy when wet. For these reasons, it can be applied during regular working hours.

Because it is so clean to handle, this new pipe insulation involves almost NO CLEANUP TIME — one of the big reasons why users report application savings up to 50%. This unusual cleanliness feature also makes it very popular in food, chemical and other plants that cannot afford to run the risk of product contamination.

Other properties are equally unusual and pleasing. G-B Snap-On pipe insulation is exceptional in thermal efficiency . . . 4 to 10 times lighter than any other . . . easy to finish . . . easy to cut with a knife . . . fire-resistant . . . rotproof . . . won't absorb moisture. But don't take our word for it — write today for samples and make your own tests. You'll find that in every respect G-B Snap-On pipe insulation is the first all new pipe insulation in 60 years!

*Trademark Reg.

gb **GUSTIN-BACON MFG. CO.**
250 W. 10th St., Kansas City, Mo.
New York • Chicago • Philadelphia • San Francisco • Los Angeles
Houston • Tulsa • Dallas • Detroit • St. Louis

For more data circle 520 on Post Card

information on valves, filters and driers for the air conditioning and refrigeration industry. Product specifications, charts, selection information are provided. New products, improved designs are illustrated. A-P Controls Corp.

156 Metal Chain — Twelve-pp Bulletin 53-56 describes user benefits of company's Rex-Z-Metal chain. Gives test data showing strength, abrasion resistance, corrosion resistance and long service life. Photos show chain in use in a variety of industrial applications from pump mills to food processing plants. Chain Belt Co.

Postage-free cards for ordering catalogs are on pages 113-114. You may also use the cards to ask for further information on the advertised products.

157 Power Machines — This 16-pp catalog discusses selling features, dimensions, operating capacities, ordering specifications, dies available for five pipe machines and power drives. Sketches show adaptations and features of equipment. Also discusses company's new "55" universal nipple, a featured accessory for power drives and bolt machines. Beaver Pipe Tools, Inc.

158 Filtration Medium — Brochure T-103 presents Kel-F described as a porous filtration medium resistant to strong acids, caustics, oxidizing agents and common organic solvents. Engineering data provided includes physical properties and minimum flow capacity curves for air and water. Porous Plastic Filter Co.

159 Floor-Mounted Condensers — Form 9041 describes a line of floor-mounted direct-contact barometric condensers for food and chemical processing industries. Contains cut-away sectional views of condensing process, showing vapor and condensing water flows. Stresses advantages of company's Motorpump used to remove spent condensing water from reservoir in bottom of the unit. Also pictures some installations and includes dimensions. Ingersoll-Rand Co.

160 Moisture Control — "Moisture-Control in Compressed Air" is a bulletin which discusses types and quantities of impurities removable by company's Vi-Speed dehumidifier-filter. Illustrates four models; tables give specifications, results to be expected. Van Products Co.

161 Improved Machine Mounts — This brochure describes advantages of self-leveling machine mounts. Tells how they enable installation and leveling of heavy machines without bolting or shims, afford increased plant mobility, reduce maintenance costs and noise. Barry Corp.

162 Automatic Flame Cutting — This 12-pp article titled, "Advanced Automatic Flame Cutting for Machinery Weldments," tells how a power shovel manufacturer converted from castings and riveted structures to weldments. Discusses problems involved in this change, tracing development and utilization of chain type flame cutting in the fabrication of units for power shovels. Tells how use of electronic tracer can improve flame cutting flexibility and increase production capacity while reducing parts cost. Air Reduction Sales Co.

Guaranteed to CLEAN BOILERS

and complete systems

OF SCALE • CORROSION
CHEMICAL DEPOSITS
OIL AND GREASE

No Acidizing

No Turbining

No Shut Downs

1200 Boilers Cleaned Without a Failure ....

SERIES 31-H Formulas

(COLLOIDAL—NON-CHEMICAL)

POSITIVE GUARANTEE!—Over two years' field testing of Series 31-H Formulas in the complete cleaning of over 1200 boilers of from 50—6,000 hp. *proves* that any boiler and system, almost regardless of condition and water source, can be thoroughly cleaned in a period of a few weeks. These colloidal formulas cannot injure metal or gasketing as they combine *only* with rust, scale, corrosion, oil and grease. WE GUARANTEE COMPLETE CLEANING OR YOUR MONEY BACK!

Series 31-H Formulas soften and remove scale, rust and corrosion, emulsify oil and grease, and carry these substances in suspension for fast removal with the blow-down. The boiler is operated normally throughout the cleaning process—no shut-downs, no turbining, no acidizing or costly chemical treatments. Not only the boiler but the complete steam and return system are completely cleaned. Continuing use of Series 16-A Water Neutralizing Formulas often eliminates water softening operations entirely and reduces blow-downs by as much as 50%.

You can use this cleaning method yourself once the proper Formula has been prescribed. Merely add to the boiler water and let it work as you operate.

SEND for free analysis sheet upon which you submit your boiler size, operating conditions, water source and other pertinent information. We will recommend the proper Formula, amounts to be used, and the surprisingly low cost. WE GUARANTEE YOU A COMPLETELY CLEAN BOILER AND SYSTEM OR YOUR MONEY REFUNDED IN FULL!

TYPICAL CUSTOMERS

OF WATER TREATMENT COMPANY OF AMERICA

Calcasieu Paper • Firth Sterling Steel • Scaife Co. • Pittsburgh Screw & Bolt • American Bridge Co. • Richmond Radiator • Owens-Illinois Glass • Cambridge Glass • Air Reduction Co. • American Steel & Wire • Newport Steel • Ohio River Steel

BAERITE — ALL WATERS RENDERED HARMLESS

OPPORTUNITY FOR STOCK CARRYING DISTRIBUTORS

A few excellent territories are open for rated distributors capable of carrying stocks and servicing exclusive areas. Factory supervision provided. WRITE in detail.

WATER TREATMENT COMPANY OF AMERICA

1159 Hodgkiss Street — Pittsburgh 12, Penna.

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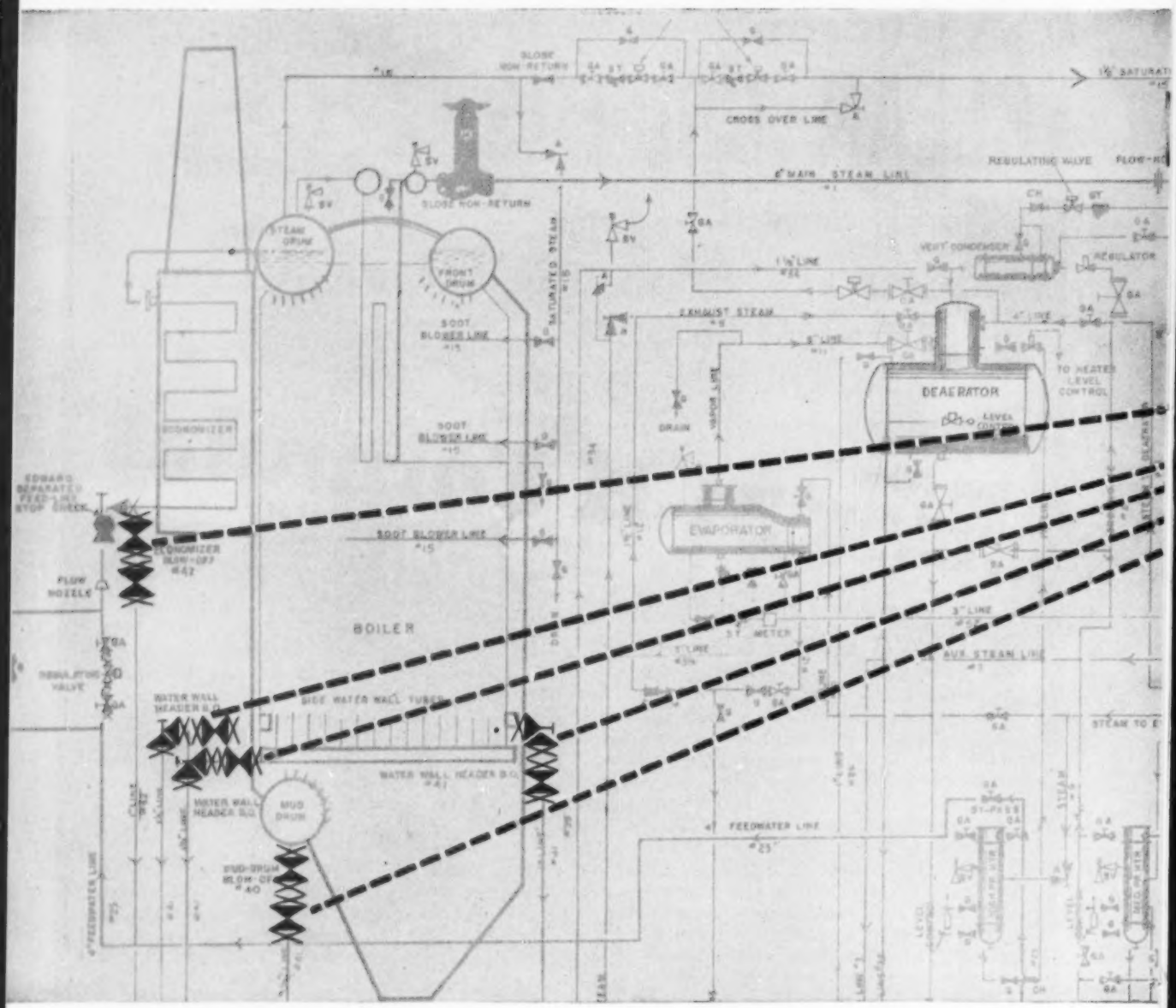
What you should know about



In the nearly 50 years since Edward designed and built the first steel blow-off valves, experience and research have revealed many facts about them. Here are some of the most important.

OPERATIONAL POINTERS

. . . that will reduce maintenance and extend life of your blow-off valves:

1 During blow-down periods, open valve nearer boiler wide, first; then, slowly open other valve. In shutting down, close second valve first; then valve nearer boiler. This procedure places greatest wear on blowing valve and insures a tight valve next to boiler. Should blowing valve show wear, erosion, etc., it can be repaired or replaced without a boiler shut-down.

2 Open blowing valve slowly to prevent damaging shock to piping. (Edward blow-off valves are slow-opening valves that operate at normal hand-wheel speeds to eliminate errors by inexperienced operators.)

SELECTION IDEAS

. . . that reduce up-keep costs:

1 Always buy two valves of same type to permit interchangeability of parts. (All Edward blow-off valves sets have interchangeable parts.)

2 Pick blow-off valves with the packing far removed from the high temperature zone. (In Edward blow-off valves packing is above a condensate cooling chamber—out of the high temperature zone.)

3 Select blow-off valves with backseats to protect and isolate packing in service. (Edward blow-off valves have line-contact backseats for positive sealing.)

4 Be certain that in the valve hookup *both* valves will stay tight. (With Edward blowing is the same design as its mate. *Both* are capable of tight shut-off.)

5 Select blow-off valves designed so that the disk *lifts* off the seat on operating instead of grinding against it. This eliminates the possibility of seat-disk galling. (Edward swivel disk construction allows disk to turn on the stem and lift vertically away from seat.)

6 Above all, avoid gadgety, involved designs. You are fundamentally interested in long, dependable service and freedom from maintenance. (Edward blow-off valves are simple in design, and have an excellent record for long, trouble-free life.)

BOILER CODE REQUIREMENTS

. . . that control blow-off valves:

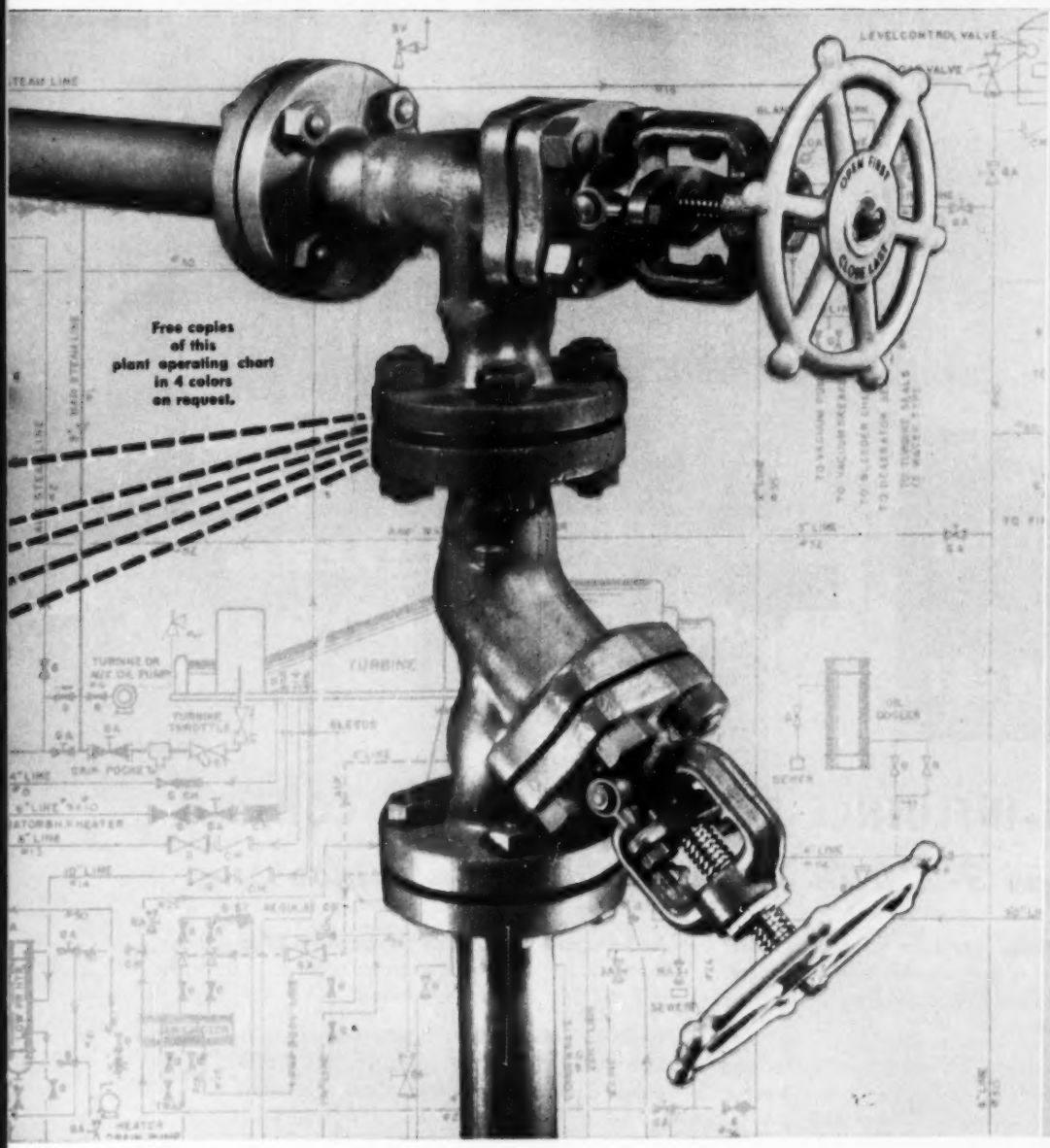
P-307

(a) A blow-off as required herein is defined as a pipe connection provided with valves through which the water in the boiler may be blown out under pressure.

P-308

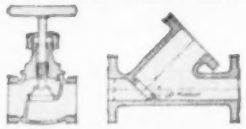
(b) Minimum size for pipe and fittings shall be 1 in., and the maximum size shall be 2½ in.

BLOW-OFF VALVES



(c) Straight-run globe valves of the ordinary type as shown in Fig. P-43A, or valves of such type that dams or pockets can exist for the collection of sediment, shall not be used on such connections.

(d) Straightway "Y" type globe valves as shown in Fig. P-43B, or angle valves, may be used in vertical pipes, or they may be used in horizontal runs of piping provided they are so constructed or installed that the lowest edge of the opening through the seat shall be at least 25 per cent of the inside diameter below the center line of the valve.



P-43A Type of Globe Valve

P-43B Type of Straightway "Y" Globe Valve

P-310

(c) Valves and fittings from the boiler to and including the required stop valves shall be equal at least to the requirements of the American Standards for a pressure 1.25 times the maximum allowable working pressure of the boiler of 1.25 times the lowest set pressure of any safety valve on the boiler drum.

(e) For pressures over 200 psi, the valves or cocks shall be of steel construction equal at least to the requirements of the American Standard for 300 psi.

Table P-15 Maximum Allowable Boiler Pressure for Feed Line and Blow-off Line under Par. P-310

Pressure Class	100	300	400	600	900	1500	2500
Std. Facing	150	416	540	785	1120	1745	2625
Ring Joint or Welded Joint	160	515	665	950	1350	2080	3120

P-311

(a) When the allowable working pressure exceeds 100 psi, each bottom blow-off pipe shall have two slow-opening valves, or one slow-opening valve and a quick-opening valve or a cock complying with the requirements of Par. P-310. By "slow-opening" valve is meant one which requires at least five 360 deg. turns of the operating mechanism to change from full-closed to full-opening and vice-versa.

***One of a series providing condensed information on valve applications in steam power plants.**

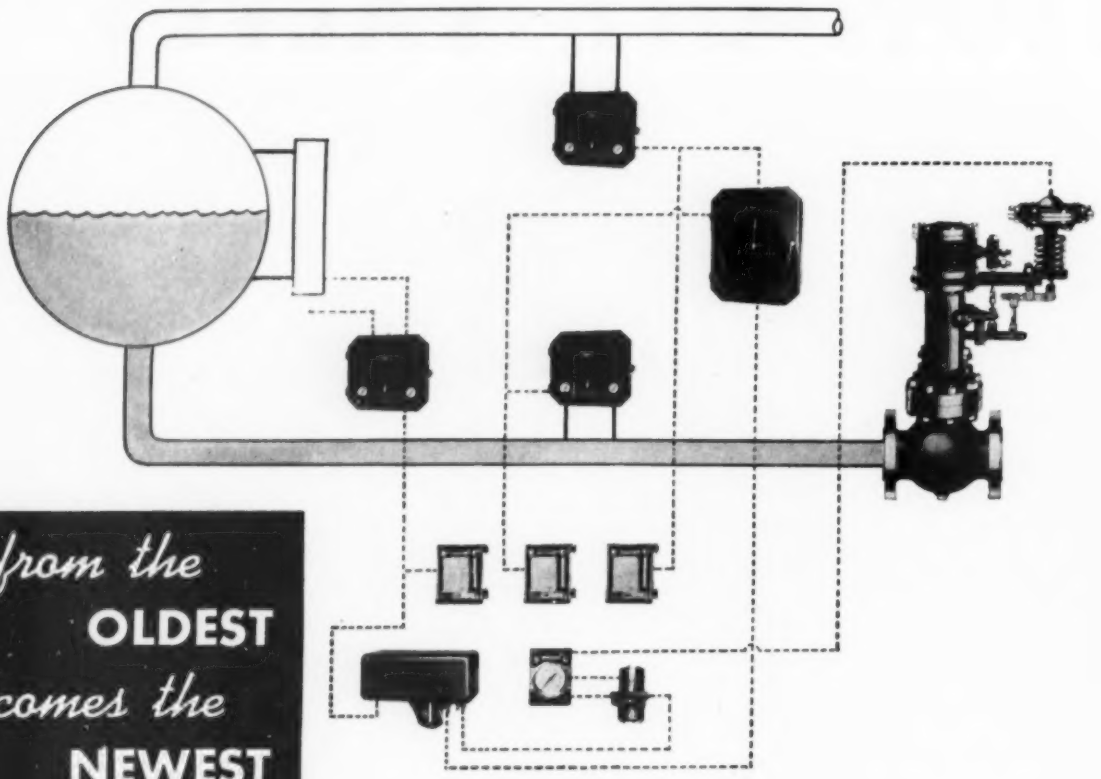
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

220 WEST 144TH STREET
EAST CHICAGO, INDIANA

Another Product

For more data circle 522 on Post Card



from the **OLDEST** *comes the* **NEWEST**

IN THREE-INFLUENCE BOILER FEED WATER CONTROL

Type 3-L with instrumentation by Taylor

COPES . . . the oldest name in boiler feed water regulation . . . now offers you the newest in three-influence feed water control. Combined in the new COPES Type 3-L are . . .

. . . the scientific balance, characterized ports and rugged dependability of the COPES control valve.

. . . plus the unequalled responsiveness and accuracy of *instrumentation by Taylor.*

And Copes-Vulcan assumes undivided responsibility for service, whenever or wherever needed . . . throughout the life of the installation.

Write for Bulletin 1013. It tells the story of the newest feed water control to come from COPES . . . the oldest name in boiler feed water regulation.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

COPES VULCAN

BOILER CONTROL

WITH INSTRUMENTATION BY *Taylor*

Three-influence mechanically-operated and three-influence electrically-operated regulators are also available.

For more data circle 523 on Post Card

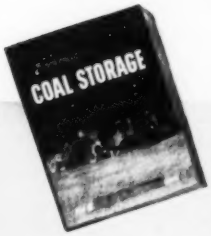
IMPROVE COAL HANDLING *Three* WAYS...

1. ADD FLEXIBILITY. Store coal wherever there is available space . . . and reclaim it any time. A-C crawler tractors, equipped with loaders, bulldozers or scrapers travel anywhere . . . over any ground. And in rush periods, you can speed up operations temporarily by transferring additional tractor units to the job.

2. HAVE EXTRA FIRE PROTECTION. When A-C tractor units store coal, they spread it in thin layers and compact it by constant travel over the pile. The tight packing of horizontal layers eliminates the flues that cause spontaneous combustion in loose conical piles.

3. REDUCE EQUIPMENT INVESTMENT. The Allis-Chalmers tractor method is considerably more economical and flexible than complex conveyor or crane systems — which means savings in original cost as well as lower cost per ton for coal handling. And tractor units can also be used for such jobs as plant and yard maintenance, material handling, car spotting and snow removal.

Send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors." Describes modern coal-handling methods, using A-C tractors and 'dozer blades, front-end loaders and scrapers. Write Allis-Chalmers Tractor Division.



● HD-5G Tracto-Shovel stockpiling coal at a large industrial plant in Cleveland... has averaged 2500 tons a month for a year and a half without ever being down for repairs.

● Tractor-Scraper Team Stockpiles Coal Anywhere. Coal brought in by water to Midwest chemical plant is economically hauled to stockpile, spread in 4-in. layers and compacted by Allis-Chalmers HD-20 Torque Converter Tractor and 25-yd. (18-ton) scraper. With tractor-scraper units that travel anywhere, storage areas can be placed wherever space is available, coal piled high if space is limited.

Four Diesel-Powered Models . . . 11,250 to 41,000 lb.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Now!...

An INTERRUPTING RATING in EXCESS of 100,000 AMPERES *for every set of fuse clips in your plant* . . . simply by installing FUSETRON *dual-element* FUSES

The Biggest Electrical Protection NEWS Since BUSS invented the FUSETRON Dual-Element FUSE

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

In 1947 tests made by the Electrical Testing Laboratories of New York, showed that on a circuit set to deliver 50,000 amperes, FUSETRON fuses in all tests cleared the circuit safely.

50,000 amp. Interrupting Capacity in 1947
becomes
100,000 amp. Interrupting Capacity Today

After years of intensive development work on FUSETRON fuses new tests were conducted under conditions that simulated the most severe field conditions and these tests were witnessed and verified by the Electrical Testing Laboratories of New York.

On circuits set to deliver in excess of 100,000 amperes, 30 to 600 ampere, 250 and 600 volt FUSETRON dual-element Fuses on each and every test cleared the circuit without belching flame or venting hot gases and with comparatively little noise.

Oscillograms of these tests interpreted by the Electrical Testing Laboratories, showed that the total available amperes including the direct current component, reached values as great as 165,000 peak amperes on 240 volt tests and as high as 212,000 peak amperes on the 535 volt tests.

This indicates that an interrupting rating of 100,000 amperes for FUSETRON dual-element fuses is a conservative one.

No interference with time-lag

In the development work to increase interrupting capacity in FUSETRON fuses it was kept in mind that the time-current characteristic must be maintained. Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses.

Remarkable results have been achieved. Interrupting capacity has been greatly increased while the time-current characteristic of FUSETRON fuses has in no way been disturbed.

Play Safe – install Fusetron Fuses throughout the entire electrical system!

Think!...

ALL THIS ADDED SAFETY *without changing a panelboard or switch... plus* 10 Point Protection of FUSETRON *dual-element* FUSES!

Maximum Safety

With FUSETRON Fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every FUSETRON fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to *pay extra* for "safe" equipment. Wherever a FUSETRON fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

When FUSETRON fuses have once been installed properly you can forget about them. They need no periodic inspections to see if they will operate safely.

Dust, fumes, corrosion or age cannot prevent a FUSETRON fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

With FUSETRON fuses — you get safety — without one cent spent for inspection or maintenance costs.

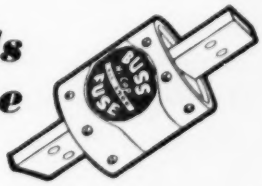
No Recalibration Costs

When a FUSETRON fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS— a fuse that is as safe and dependable as the one that blew.

PLUS 10 POINT Protection with FUSETRON dual-element FUSES

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

for SAFE PROTECTION on loads above 600 and up to 5000 Ampere install BUSS Hi-Cap FUSES



Tests have shown that BUSS Hi-Cap fuses have unlimited interrupting capacity on circuits of 600 volts or less.

They are designed to give protection against dangerous overloads as well as high fault currents — yet their speed of operation on heavy shorts limits currents to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with FUSETRON dual-element fuses they will not open ahead of the fuses nearest to the fault. Thus trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

ACTION THAT SAVES YOU MONEY

By passing the word along that all purchase and stock records should call for FUSETRON fuses on loads up to 600 amps—and BUSS Hi-Cap fuses on loads above that — you get action that begets money saving.

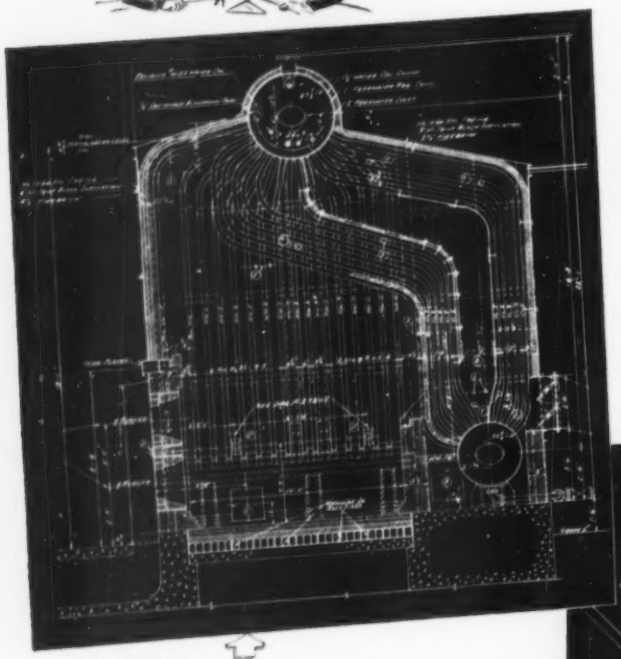
For blowing time charts or more information on FUSETRON Fuses and BUSS Hi-Cap Fuses write for Bulletins FIS and HCS.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. Division McGraw Electric Company

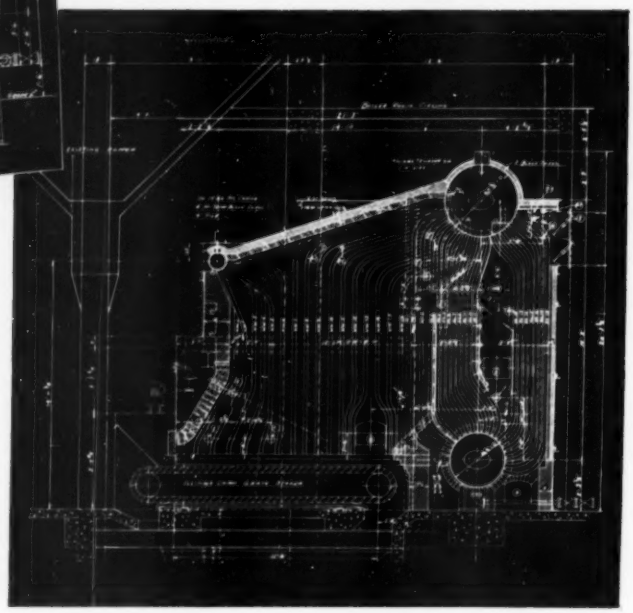
For more data circle 525 on Post Card

Industry Approved

Two-Drum STEAM GENERATORS by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

FOOD PROCESSING PLANTS

DISTILLERIES • HOTELS

HOSPITALS • CHEMICAL PLANTS

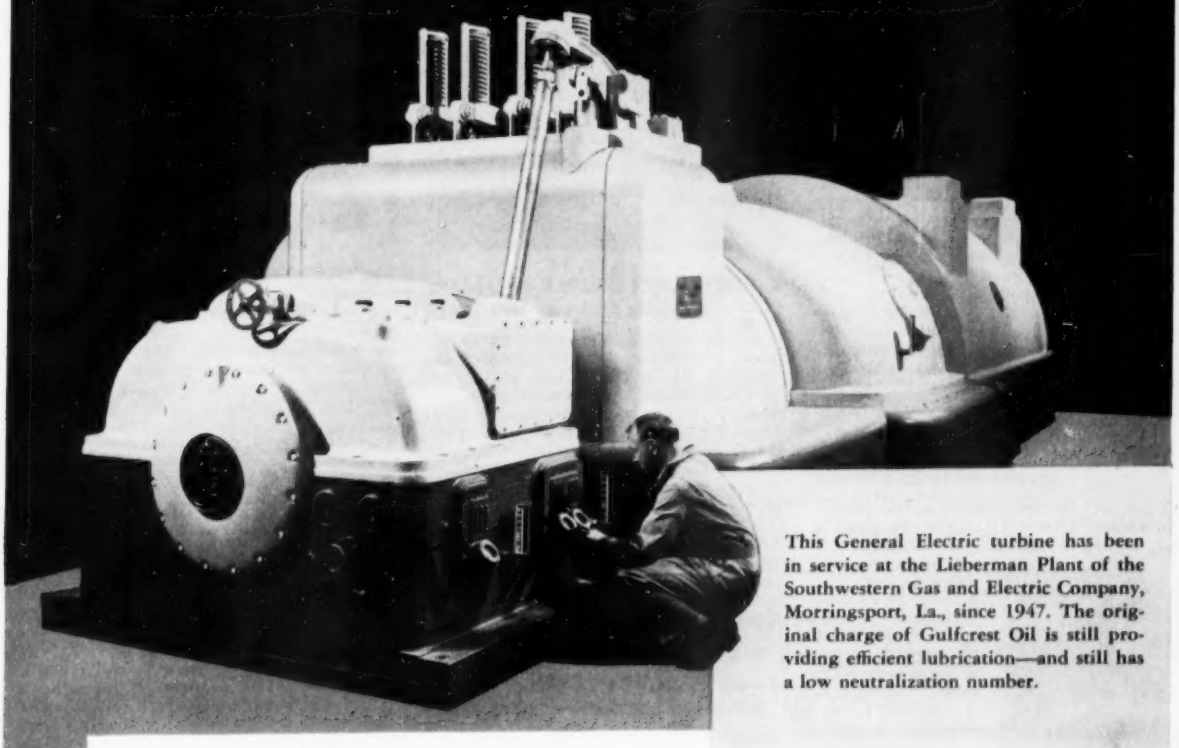
PETROLEUM REFINERIES

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

For more data circle 526 on Post Card

the RIGHT oil for every steam turbine –
GULFCREST



This General Electric turbine has been in service at the Lieberman Plant of the Southwestern Gas and Electric Company, Morringsport, La., since 1947. The original charge of Gulfcrest Oil is still providing efficient lubrication—and still has a low neutralization number.

the RIGHT base stock, super-refined

the RIGHT combination and concentration of additives

the RIGHT background of performance

Gulfcrest Oil has a background of successful performance in every type and make of steam turbo-generator.

In many of these installations, the original charge of Gulfcrest has been in service more than 15 years with no significant change in its original characteristics, and with neutralization numbers always remarkably low and safe. That is why Gulfcrest Oil is acclaimed "the world's finest turbine oil."

You'll be joining an impressive group of well satisfied users when you fill your turbine system with this outstanding oil.

Call in a Gulf Sales Engineer and ask him to recommend the proper grade. Or write to the Gulf Oil Corporation, 1822 Gulf Building, Pittsburgh 30, Pennsylvania.

GULF INDUSTRIAL LUBRICATION

For more data circle 527 on Post Card

EQUIPMENT NEWS

1—LIGHTNING ARRESTER is improved, station-type

The Thyrite Magne-Valve Arrester is announced as attaining 20 per cent lower IR discharge voltage, 10 per cent lower sparkover voltage and three times greater discharge capacity and endurance than company's previous model. It combines magnetic action of a new type gap unit with valve action of Thyrite material, the design of the gap unit including parallel sets of gap electrodes connected in series with magnetizing coil. This gap unit has a lightning sparkover path across one gap, but has the arc-interrupting path across as many as 14 multigaps. This is said to permit arrester's sparkover sensitivity to be controlled independent of its arc-interrupting efficiency. General Electric Co.

2—STEAM TRAPS heat up steam units in a hurry

Tests of the new Heat-Kwik Super-Silvertop Steam Trap are reported to show that it vents air out of steam consuming units eight times faster than many inverted bucket traps, and three times faster than air eliminator or blast type traps tested. More production, lower steam consumption and longer trap life are also claimed.

According to manufacturer, the trap's fast air-venting is achieved by means of two orifices, one for condensate and a separate bellows orifice for air. When the trap is cold, the bellows orifice is wide open and handles large quantities of air rapidly. After all of the air is removed through it, the bellows expands and closes the orifice; air is removed through the vent hole.

These traps require a trap factor of never more than 2 to 1, says company, and this low trap factor enables the use of a less expensive Heat-Kwik Steam Trap than normally required. The head of the trap may be opened for inspection or servicing without removal from the pipeline. The trap comes in sizes from ¾ to 1¼ in., suitable for pressures to 150 psi. The V. D. Anderson Co.

Described here are new and newly improved products. Use the Reader Service Cards on page 113 to ask for more information on them. Just circle item numbers of all the products in which you are interested.

3—STEEL ENCLOSURES for safety switches, circuit breakers

Lead-plated sheet-steel enclosures for safety switches and circuit breakers are designed for outdoor use and other special applications where cast-iron enclosures have been previously used. They are expected to find wide application where humid, dust-laden and corrosive atmospheres prevail, such as those of steel mills, breweries and chemical plants. According to test data reported, the inert lead coating resists corrosive effect of acid, alkali and salt spray. These lead-plated enclosures are also described as lighter in weight than cast-iron types, and easier to handle and install. Trumbull Components Dept., General Electric Co.

4—PIPE THREAD COMPOUND, good lubricating properties

Suggested for use on chrome, chrome plate, nickel steel, ceramic and plastic pipe threads, and for joining or connecting dissimilar materials is the recently developed Flexrock 25, Teflon Pipe Dope. Its lubricating qualities are said to prevent galled threads and to permit easier pipe joining, that can be readily dismantled even after long periods of exposure to rigorous conditions.

Tests made on lines conveying strong acids, alkalis, and solvents at temperatures from −150 to 500 F are reported to indicate good sealing achieved without application of maximum torque. The new compound has been formulated for easy application and good adhesion to pipe threads, says manufacturer, and its biological inertness widens its field of application. It is available for test purposes in 4 oz test cans priced at around $5.00. Packing Div., Flexrock Co.

5—METER is now available with new signal transmitter

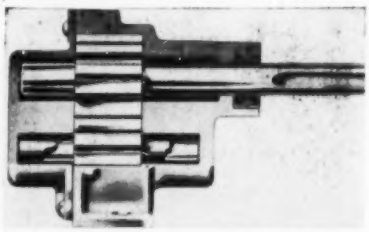
A specially designed pneumatic signal transmitter is available for this manufacturer's Ring Balance Meter which is said to make the instrument readily adaptable to many remote metering and control applications, including control installations requiring reset, remote adjustable set point and rate action.

The new transmitter is actuated by movement of the pen arm or indicator follower of the Ring Balance Meter, these movements being transmitted to a baffle which moves about a fixed pivot to throttle air discharge from the control nozzle. Sensing element movement is, therefore, converted into a proportional pneumatic signal that follows the function measured.

Available maximum signal pressure ranges are 15, 30 and 60 psi. This requires a continuous supply of compressed air. Output from the transmitter can be used to actuate receiver type indicating, integrating or recording instruments, or as the actuating signal for an automatic control system. Operating in conjunction with a Ring Balance Meter, compensated for temperature and pressure, the transmitter produces an output signal on the basis of "corrected quantity," company explains. Gas flow measurement, for example, can be recorded as cubic feet per hour at base conditions chosen. Hagan Corp.

6—GEAR TYPE PUMP handles light or heavy liquids

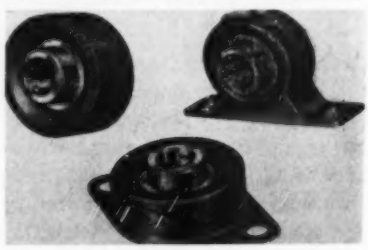
The EO Pump is designed for light liquids with speeds to 1725 rpm or for heavy liquids, such as molasses and heavy oils, at slower speeds. According to manufacturer, the gear-type construction of the pump permits pressures to 100 psi. It can be operated in either direction of rotation. Carbon bearings,



bronze alloy gears and case and stainless steel shaft are features of the pump, and its simple construction is said to contribute to long life and minimum servicing. The pump is available as a complete unit with pump, base, coupling and motor; as a complete assembly less motor; or as a replacement with pump only. Eclipse Fuel Engineering Co.

7—BALL BEARING UNITS for reduction of noise, vibration

This manufacturer's Sealmaster Bearing Units are now available in rubber mountings with pressed steel housings. Six shaft sizes from ½ to 1 in. are manufactured and are available as pillow blocks, flange units and cartridge units. These new bearings are declared particularly



adaptable for use on air conditioning equipment and other light duty uses.

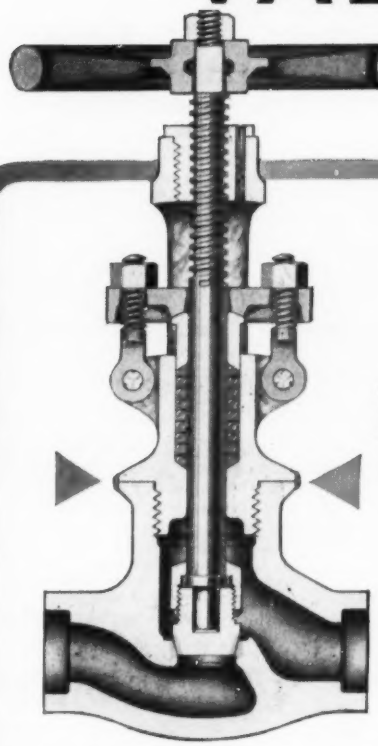
The synthetic rubber mounting rings are described as oil- and grease-resistant, and lubricated for life. It is pointed out that company's Zone Hardening process used on the inner race ring of the ball bearing units heat treats through the ball path section only. Since the extended

newest in small steel valves for high-pressure/high-temperature

CRANE

lip-seal bonnet (patented)

VALVES



Lip Seal design is exceedingly simple. Body and bonnet are screwed together until a firm metal-to-metal contact is made between the smoothly machined flat surface on the shoulder of the bonnet and the top of the body. The small lips around the periphery are then seal welded.

- **Absolute Bonnet-Joint Tightness**
- **Freedom from Bonnet-Joint Maintenance**
- **Minimum Weight and Bulk**
- **Easier Dismantling and Reassembly**

1500 AND 2500-POUND GLOBE AND ANGLE PATTERNS
SOCKET-WELDING AND SCREWED ENDS. SIZES ½ TO 2-INCH

What better way to seal against leakage at the bonnet joint of a small steel valve . . . than with a simple weld. And that's all the weld is ever called upon to do. Extra-long body-bonnet threads carry all mechanical loads—and at comparatively low stresses. Should dismantling be necessary, the seal weld may be repeatedly ground off—and reapplied—without damage to valve.

Right along with this modern Crane sealing principle go other important refinements. You get a compact, weight-saving structure without sacrificing strength or reducing seat area—a more rigid swivel disc-stem connection—durable Stellite-faced plug-type disc—and Stellite-faced integral seat.

Crane Lip-Seal Bonnet Valves are by far your best buy for high-pressure/high-temperature power services . . . worthy companions to the larger Crane Pressure-Seal Valves. Ask your Crane Representative for Circular AD1902, or write direct.

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portions of the race remain unaffected, the hardened threads of the set screws are able to bind tightly against the soft threads of the race for positive race to shaft locking. Further details are these bearing units provided in Bulletin 1253. Stephens-Adamson Mfg. Co.

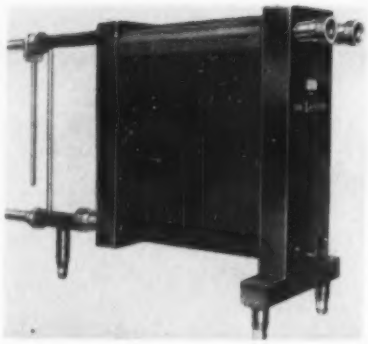
8—SOUND ABSORBERS for economical reduction of noise

A new approach to the problem of industrial noise by the use of small, portable, and easily installed sound absorbing units is announced. Known as Sonosorbers, the units have inner cores encased in perforated stucco embossed aluminum. They weigh about 2½ lb each, are described as non-flammable and easy to clean. They are suggested for locations where other acoustical treatment is not applicable or adequate.

According to company engineers, Sonosorbers have high value of noise absorption in both high and low frequencies — they are volume absorbers with absorption areas larger than their physical dimensions in certain frequencies. In an intense sound area, their physical structure tends to break up sound waves, it is explained, to attract and absorb or drain the sound due to diffraction. Sonosorbers are about 24 in. long, and are hung on 2-, 4-, 6- or 8-ft centers or as desired. It is pointed out that their use does not necessitate alteration or moving of sprinklers, lighting fixtures, skylights or ventilating equipment. They are usually hung near the noise source. Sonosorber Corp.

9—POWER DRIVE for operating hand pipe tools

The 88 Power Drive is designed for fast, efficient operation of hand pipe threaders, cutters and reamers. Use of aluminum housing has resulted in a weight of only 140 lb, it is pointed out, and increases the ease of portability of this compact, rugged unit. It converts hand tools to power in the shop or on the job, and can be mounted on bench or service truck or furnished with legs and tool tray. Capacity of the drive is given as ⅛- to 2-in. pipe, ¼- to 1½-in. bolts; and with universal drive shaft, geared die stocks and cutters up to 12 in. It incorporates a ½ hp motor. Toledo Pipe Threading Machine Co.



11—PLATE HEAT EXCHANGER for industrial processing

High efficiency and lower operating costs are claimed for this plate heat exchanger; it is suggested for many industrial processes, where heating, cooling or regeneration are required.

Chief among the features announced are the plates themselves. Pressed from heavy stainless steel stock, and having a deeply corrugated surface, they are designed to withstand higher-than-average operating pressures. The corrugated design is said to result in high velocity and extreme turbulence of the liquid, and the heat transmission coefficient is declared unusually high. The design is such as to permit thorough "in-flush" cleaning. Because the plates are invertible, the heat exchanger may be altered from time to time to adapt it to changes in the operation, it is pointed out, and inlet and outlet parts in the plates can be varied without use of new or extra plates. The DeLaval Separator Co.

12—PLASTIC WATER SEAL is easy to apply; won't crack

Vike Water Seal is announced as an easy-to-apply plastic material for sealing pipe joints, screw threads and flanges on joints handling water, air, ammonia, gas and steam. Joints sealed with this material can be broken easily when necessary, it is claimed. Manufacturer says seal will not shrink, crumble or crack, and contains no corrosive substances. It is available in sizes from 1-lb to 400-lb drums. Keystone Lubricating Co.

13—STEAM REGULATOR designed with "fail safe" feature

The SFS Steam Regulator is announced as having a self-closing return feature which prevents overheating through an override by accidental damage to the thermostatic steam regulator element. According to manufacturer, it "fails safe" by automatically closing a direct acting valve when the element accidentally fails. A reverse acting model opens the valve to prevent an override of the temperature being controlled.

Functioning of the "fail safe" feature is achieved by means of a thermostatic element and temperature adjustment, designed to close a direct-acting valve (or open a reverse-acting one) when the thermostatic element is accidentally damaged and loses its charge. The regulator has bronze body, union ends and bellows bracket. The thermostatic element is of the vapor tension type and comes with 6 ft of armored capillary tubing, copper thermo bulb and tank bushing. Lawler Automatic Controls, Inc.

14—BAR HANGER offers adjustability, extra strength

A special shape adds tremendous strength to this bar hanger, says manufacturer. Adjustment is provided by a telescoping action of the two halves of the hanger, similar to the action of an adjustable curtain rod. Another advantage announced is the clip which secures the box to the bar without interfering with

device space in the box, and which provides added wiring room.

The bars come in clip and stud styles, each available in two sizes to fit various studding spacings. Both styles fit furring and studdings from 1 by 2 in. to 2 by 4 in. and all sizes of joists and rafters. According to manufacturer, this is the only bar hanger designed to fit modern shallow-wall construction. Raco Div., All-Steel Equipment Inc.

15—CHEMICAL PUMPS for acids and caustic solutions

A new line of end-mounted chemical pumps for acids, caustic solutions, solvents and liquefied gases consists of 27 models suitable for heads up to 600 ft in a single stage and capacities from 1 to 100 gpm. All models have high pressure flanged connections and are available in several metals. Seven types of mechanical seals are furnished, each in several combinations of metals and gasketing. More information available in Section 109. Roy E. Roth Co.

16—OIL SKIMMER for reclaiming oil used in manufacturing

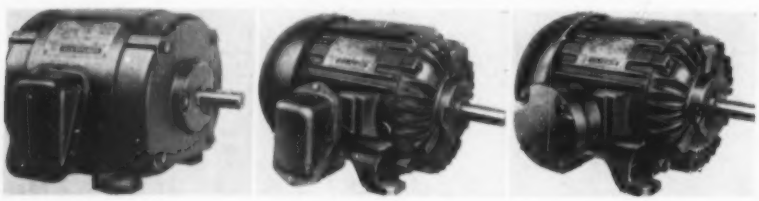
Operating from the liquid level in a chamber through which oil is flowing, this device is designed to automatically and constantly skim oil from liquid surfaces, regardless of the liquid levels in the collection tanks or chambers. Manufacturer says it can be applied wherever reclamation of oil exists; it also provides a means of preventing oily waste discharge into rivers and streams.

The oil skimmer consists of: a movable trough with rollers and supporting guide

10—INDUCTION MOTORS, same horsepower capacity, smaller sizes

A new line of a-c squirrel cage induction motors in frame sizes 326 and smaller, following the new NEMA standards, is announced. Open drip-type, totally-enclosed fan-cooled standard, and totally enclosed fan-cooled explosion proof models (as pictured, left to right) are included in the new line. In appearance, they will be similar to manufacturer's present designs. They will have cast-iron frames and end shields and aluminum rotors. Bearings will be grease lubricated, medium series, double-shielded ball bearings, which can be re-lubricated without having to dismantle the motor.

In the new open motor, intake openings in the end shields have greater protection than in the old design, according to company. Located in the bottom half of the end shield, these openings are high enough above the base to minimize the probability of incoming air sweeping dust or lint from the floor or base. Production is now underway on these new motors in frame sizes 182 and 184 and the larger frame sizes are expected to become available later. Allis-Chalmers Mfg. Co.



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rod; a hydraulic cylinder with compound lever attachment; a four-way hydraulic valve with hydraulic power pack; and a counterweighted float and cable assembly. These four groups of equipment are mounted on the wall of a chamber, with float and trough operating in a vertical plane. Operating mechanisms are stainless steel or bronze, while other metal parts are covered with heavy preservative coatings.

In operation, the float moves up or down with the level of the liquid in the tank and maintains the trough at such a level that its lip is a little below the liquid. Since the oil to be reclaimed floats on the surface of the liquid, it flows over the lip and is filtered through screens. Simplex Valve and Meter Co.

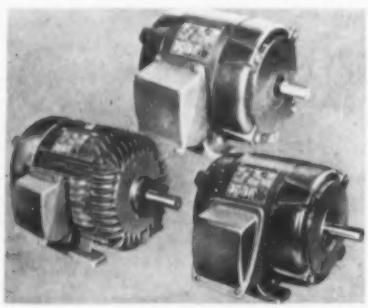
17—INDUCTION MOTOR is smaller, better ventilated

A new induction motor, the Life Line-A is announced as offering improvements in ventilation, insulation and bearings, and as being quieter and smaller, conforming to new NEMA standard dimensions. It comes in three enclosures — totally-enclosed fan cooled, totally-enclosed non-ventilated, and dripproof, as shown from left to right.

Wire, coil, dip and cable insulations are new. The Bondar wire insulation is a synthetic resin with high thermal endurance. Coil insulation is a combination of Mylar polyester film and rag paper for dielectric strength and heat endurance. The Bondite dip insulation is a phenolic alkyd thermosetting type varnish with silicone incorporated.

The ventilation system on the dripproof motor is such that this new model is declared suitable for both indoor and outdoor use, and wherever a totally enclosed motor is not required. A straight-through ventilation design, it has the openings located in one quadrant of the rim of the end bracket to protect motor from overhead drippings no matter how it is mounted. And because of the improved ventilation, the splashproof enclosure is eliminated.

The Life Line-A has a "four-way" bearing seal. There are two seals on each side of the bearing — a stationary inner seal and an outer seal which rotates and is attached to the inner bearing race, the latter one acting as both seal and flinger to throw off foreign particles. In



the totally-enclosed motors, a bearing by-pass is provided to prevent the motor from breathing through the bearing by equalizing pressure on each side of the bearing, and this, with an external flinger, serves to keep out contaminants.

The new motors have cast iron frames, corrosion-resistant finishes. In conforming to NEMA standards for dimensions of motors from 1 to 30 hp, they are smaller per horsepower and quieter than formerly. Westinghouse Electric Corp.

18—SHAFT MOUNTED DRIVE, steel with helical gearing

This new speed reducer mounts directly on the shaft to be driven and requires no floor space other than that needed for the motor and tie rod connection. Easily adapted to various driven shaft

diameters, this drive is said to offer comparatively high ratios of speed reduction in limited space. A choice of single or double reduction unit permits the selection of almost any output speed between 420 and 14 rpm, merely by changing sheave sizes within allowable limits. Six sizes cover the range from ½ to 30 hp. The Falk Corp.

19—ZINC ANODES, seven types for cathodic protection

A new line of seven zinc anodes, developed to meet requirements for specific types of underground or underwater installations, is announced. These new zinc anode shapes are designed to meet such known applications as pipelines, water tanks. The New Jersey Zinc Co.

20—CAPACITOR EQUIPMENT for secondary networks

Completely assembled capacitor equipment for installation on secondary network systems is said to be especially suited for urban distribution systems where air-conditioning and other low power factor equipment is present. Units are company's standard outdoor type, rated at 13⅓ kvar at 216 v. Equipment is available for 40, 80 and 120 kvar, three-phase, and may be stacked three high or arranged to fit available vault space. The submersible capacitor units are zinc sprayed; the frame is galvanized. Westinghouse Electric Corp.

21—TESTING KIT for routine checks on water hardness

Field tests of water hardness sensitive to 1 grain per gallon (17.1 ppm) are said to require only a minute with the new Speedy-Kit. A sample of water is measured into a marked glass vial; 2 drops of Solution A are added, turning the water red. Solution B is then added, until the red color changes to blue. Each drop of Solution B represents 1 grain per gallon of hardness.

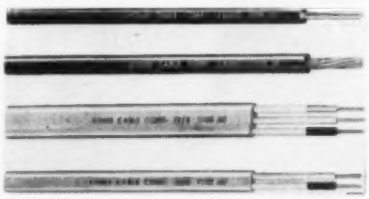
This procedure is described as a simplification of the Schwarzenbach methods, and is expected to be of value in routine water-hardness checks. However, the more elaborate modifications of the Schwarzenbach method are suggested where a more precise determination is needed, as in boiler water treatment.

The Speedy-Kit is pocket size, weighs 6 oz. Its plastic box contains a glass vial, a glass bottle of Solution A and a plastic bottle of Solution B. The cost per test is reported low, and there are sufficient reagents in a kit for 50 to 100 tests, depending on water hardness. The kit was developed by Hall Laboratories, Inc., is announced by Calgon, Inc., and Hagan Corp. Bulletin 5RE54 gives details. Hagan Corp.

22—ELECTRICAL CABLE for branch and feeder circuits

Designed for underground feeder service and locations where dampness or corrosive action are encountered, FlexAll is available in single-, two- and three-conductor construction. According to manufacturer, the single-conductor FlexAll is UL approved as Type UF (underground feeder) and the multiple-conductor construction is approved as both Type UF and Type NMC (nonmetallic sheathed cable — corrosive resistant).

Thus, both types are suggested for branch or feeder circuits buried in earth, when provided with suitable overcurrent protection, and the multiple-conductor



type also for interior wiring, exposed or concealed, and in wet or corrosive locations, installation in hollow spaces of masonry block or tile walls, or embedded in plaster or shallow chase in masonry when suitably protected.

Both types are insulated with a thermoplastic compound, and individual conductors in the multiple-conductor FlexAll are covered with glass yarn. Single-conductor FlexAll comes in sizes 14 through 4 AWG; multiple-conductor, in sizes 14 through 10. Bulletin RF-1 gives full data. Rome Cable Corp.

23—SIGNAL ARRESTER, valve type, for lightning protection

The Type L Signal Arrester is designed to provide lightning protection for a-c circuits of 0 to 175 v or for d-c circuits of 0 to 30 v. It is said to furnish consistent sparkover, high discharge capacity, and low IR drop. Although designed for protecting railway signal systems, the Type L is suggested for other low voltage systems, such as fire alarm circuits, remote metering circuits, and relay circuits. It consists of a precise spark gap and valve element in a clear plastic housing, all mounted on a Bakelite base. Line Material Co.

24—TIME DELAY RELAY, small sized, hermetically sealed

Designed to take up less space than previously required, these time delay relays can be supplied with 50, 60 or 400 cycle a-c or governed or standard d-c motors. Accuracy and low power consumption are stressed. The unit is enclosed in a lightweight aluminum housing of 2½-in. dia. — it weighs about 1 lb. Basic length for a single switch unit is less than 3 in. Governed or filtered motors, special or extra switches increase this length slightly. Three-stud or flange mounting is available. A bulletin is offered. The A. W. Haydon Co.

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ENGINEERING *News*

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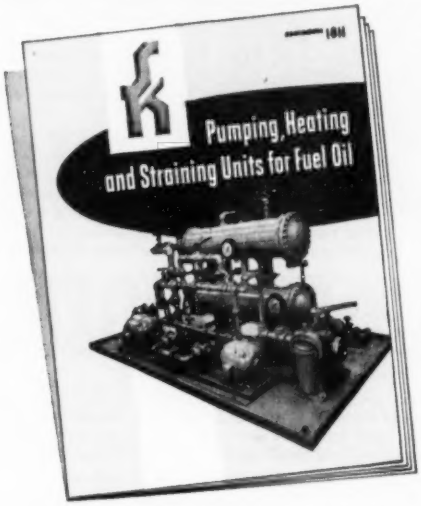
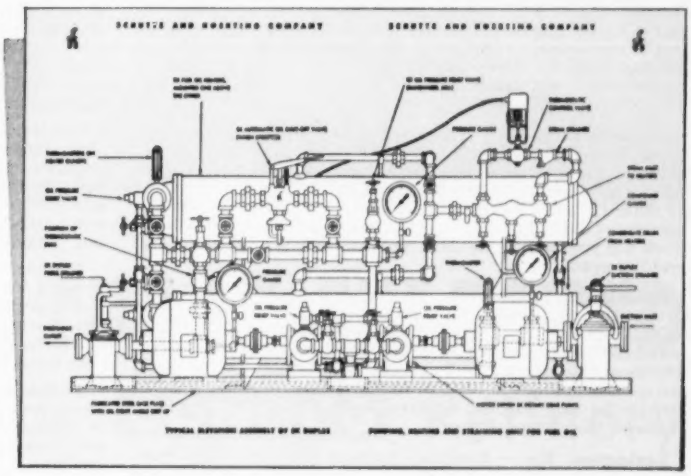
POWER ENGINEERS WHO HAVE "PACKAGED" SK PUMPING, HEATING, and STRAINING UNITS SAY, "DEPENDABLE, REQUIRE LITTLE MAINTENANCE"





YOU CAN FIND OUT WHY BY ASKING FOR A COPY OF NEW BULLETIN 16-H

Checking back on installations is a 77 year old SK tradition which pays off for both our customers and ourselves. They get an opportunity to consult with our engineers about the equipment and techniques of operation. We get a chance to hear stories like these about SK Pumping, Heating and Straining Units—

At the plant of a large paper manufacturer:—SK Unit handles 40 gpm Bunker "C" Fuel Oil at 300 psig oil pressure. Oil temperature runs 90° F.—225° F. One pump of the unit is motor driven; the other has steam turbine drive. Customer says it does a *good* job.

At the plant of a famous brewing company:—An SK Duplex Pumping, Heating, and Straining Unit handles 19 gpm of Bunker "C" Fuel Oil at 125 psig. Oil suction temperature is about 90° F., oil heater outlet temperature is about 200° F., steam pressure averages about 125 psig. The plant engineer considers the equipment to be "highly satisfactory in every respect."

At a large hospital:—SK Pumping, Heating, and Straining Unit is equipped with one horizontal duplex steam driven piston pump and one SK motor driven pump. Engineer says of unit, "It's dependable, requires little maintenance."

SK Pumping, Heating, and Straining Units are described, with principal components, in *new* Bulletin 16-H, just released. You can get a good idea of how these units are designed, how they operate, what special modifications can be made, what their characteristics include by writing for this bulletin at the address below.

Remember, the bulletin is 16-H.

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CONSTRUCTION NEWS

Bakersfield, Calif. — California Portland Cement Co., 612 South Flower St., Los Angeles, Calif., plans power plant at proposed new cement mill in Kern County, near Bakersfield, where site is being secured. It will consist of several large production units, equipped for heavy daily output. Entire project is reported to cost about $10,000,000.

Bishop, Calif. — Los Angeles Department of Water & Power, 207 South Broadway, Los Angeles, Calif., plans new city-owned hydroelectric generating plant on Owens River, near Bishop, where site has been selected. It will consist of a power dam in vicinity of Owens River Gorge, reservoir and generating station, latter to be equipped with hydraulic turbines and electric generators with rated capacity of 2350 kw. Project is estimated to cost about $2,775,000. Proposed to proceed with project soon. Engineering Division is in charge.

Devon, Conn. — Connecticut Light & Power Co., 36 Pearl St., Hartford, Conn., will proceed with proposed expansion of steam-electric generating station at Devon, previously referred to in these columns. Additional equipment will be installed for increased capacity. No official estimate of cost announced. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., is engineer and will supervise construction.

Calumet City, Ill. — Prime Oil Refining Co., subsidiary of Wood River Oil & Refining Co., Inc., 321 West Douglas St., Wichita, Kan., plans steam power house at proposed new oil refining plant at Calumet City. It will consist of several large units for refined oils and gasoline manufacture, with crude oil charging capacity of 15,000 bbl. per day. Cost estimated about $10,000,000. Work will proceed at early date. Fred C. Koch is president of first noted company.

Hammond, Ind. — Allby Asphalt & Refining Corp., care of C. Wayne Barbour, president, Allied Materials Corp., Brant Bldg., Oklahoma City, Okla., recently organized by Mr. Barbour and associates, plans steam power plant at proposed new asphalt refinery at Hammond. It will consist of several units for processing and general production, with rated capacity of 50 million gals. of asphalt per annum. Cost reported about $2,000,000. Work will be placed under way at once.

Lexington, Ky. — Kentucky Utilities Co., 159 West Main St., has authorized construction of a new steam-electric generating station at Dix River dam, near Lexington, to be developed in four units, with ultimate rating of approximately 425,000-kw. Coal will be used as fuel. Work on initial unit is scheduled to begin this spring. Entire project is reported to cost over $50,000,000, and will be carried out over a period of several years. Program will include power substations, transmission lines and other operating facilities.

New Orleans, La. — Anheuser-Busch, Inc., 721 Pestalozzi St., St. Louis, Mo., beer, ale, yeast, etc., plans power plant at proposed new brewery in Jefferson Parish, La., near New Orleans, where tract of 150 acres of land has been secured. It will consist of a series of one and multi-story buildings, equipped for large capacity. Cost estimated about $20,000,000. Work is expected to be placed under way at early date. Rosswell E. Hardy is vice-president in charge of production.

St. Mary's Parish, La. — Columbian Carbon Co., 41 West 42nd St., New York, N. Y., plans steam power house at proposed new carbon black plant in St. Mary's Parish, where tract of property has been selected. It will comprise several large processing and production units, equipped for a rating of 5 million lbs. per mo. Cost reported over $3,000,000. Work will be placed under way soon.

Wiscasset, Me. — Central Maine Power Co., 9 Green St., Augusta, Me., has authorized expansion in steam-electric generating station at Wiscasset, with installation of new turbine-generator unit, high-pressure boiler and accessory equipment. Entire program is reported to cost about $7,000,000, and is scheduled for completion by close of 1955.

Yarmouth, Me. — Central Maine Power Co., 9 Green St., Augusta, Me., plans new steam-electric power plant at Yarmouth. Installation will comprise a 50,000-kw. turbine-generator unit and auxiliary equipment, high-pressure boilers and accessories, with switchyard and miscellaneous structures. Cost reported about $10,000,000. Work is scheduled to begin soon.

Baltimore, Md. — Consolidated Gas, Electric Light & Power Co., Lexington Bldg., has arranged a construction budget for 1954 totaling about $30,000,000 for new plants and facilities. Program will include work at Hawkins Point generating plant, begun in 1952 and to be completed in 1956; it will have an initial rating of 125,000-kw. Project includes power substations, transmission lines and other operating facilities.

Escanaba, Mich. — Escanaba Municipal Utilities, Escanaba, has plans under way for new municipal steam-electric power plant, with capacity of 10,000-kw. Estimates of cost and details are being determined. Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

Montague, Mich. — E. I. duPont deNemours & Co., Inc., Organic Chemicals Div., Rubber Chemicals Dept., duPont Bldg., Wilmington, Del., plans steam-generating station at new plant at Montague, where tract of 1000 acres of land has been acquired, for manufacture of "Neoprane", synthetic rubber. It will comprise a number of one and multi-story buildings, equipped for heavy output. No official estimate of cost announced — will represent investment of several million dollars.

Atlantic City, N. J. — Atlantic City Electric Co., Kentucky and Pacific Aves., is arranging for sale of a bond issue totaling about $10,000,000, considerable part of proceeds to be used for expansion and improvements in plants and system.

Linden, N. J. — Public Service Electric & Gas Co., Public Service Terminal, Newark, N. J., is acquiring a tract of about 34 acres of meadow land near Linden, and will use as site for new steam-electric generating station. Plans will be prepared soon and details of installation determined, including turbine-generator, high-pressure boilers and auxiliary equipment. Initial cost estimated about $7,000,000.

Cleveland, Ohio — City Light & Power Div., City Hall, plans expansion in steam-electric generating station, with installation of a new turbine-generator unit, estimated to cost about $3,000,000; also diesel-electric unit for auxiliary service, to cost approximately $250,000. Work is part of a general extension program, including power substations, lines and other facilities. Vincent M. DeMelto is commissioner in charge of division.

Medford, Ore. — California-Oregon Power Co., Medford, and Yreka, Calif., has secured permission to construct and operate a hydroelectric power plant on Klamath River, Klamath County, Ore. License covers a period of 50 yrs. Project will include a power dam, reservoir and generating station, and is estimated to cost about $9,000,000.

Portland, Ore. — Pacific Power & Light Co., 920 S.W. 6th Ave., has arranged for sale of a bond issue of $8,000,000, portion of proceeds to be used for expansion and improvements in plants and system, including increased generating and other operating facilities.

Columbia, S. C. — South Carolina Electric & Gas Co., 328 Main St., has arranged an expansion and improvement program in plants and system for period of 36 mos., through 1956, to cost about $62,000,000, including increased generating capacity, power substations, transmission lines and other facilities.

Memphis, Tenn. — Atlas Powder Co., Delaware Trust Bldg., Wilmington, Del., plans boiler house at new plant at Memphis, for manufacture of emulsifiers. It will comprise a main unit for processing and general production, and several auxiliary structures. Cost estimated close to $1,000,000.

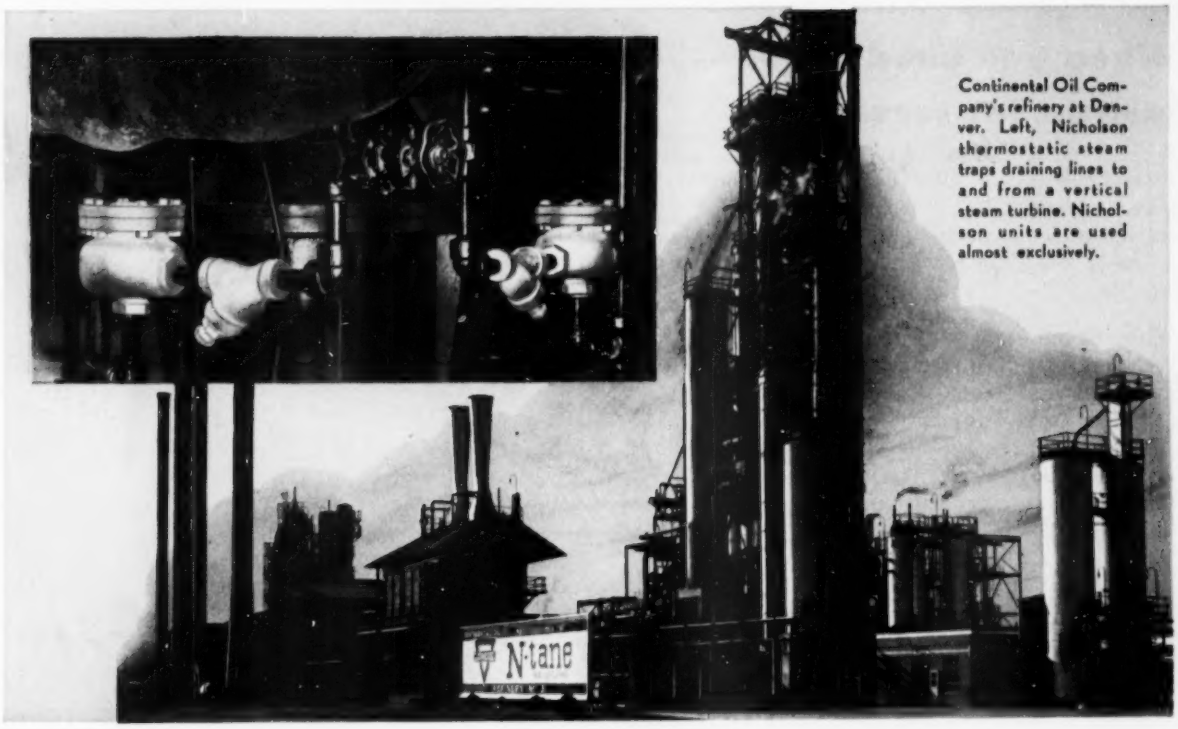
Houston, Tex. — Houston Lighting & Power Co., Fannin and Walker Sts., has authorized an expansion and improvement program in 1954, to cost about $40,300,000, including increase in generating facilities, power substations, transmission lines.

San Marcos, Tex. — Cone Mills Corp., Greensboro, N. C., cotton goods, rayon fabrics, etc., plans boiler house at new cotton mill at San Marcos. Large tract of land has been acquired. Project will include a main one-story structure, about 350,000 sq. ft. floor space, and several smaller units. Entire project is reported to cost over $5,000,000. Lockwood, Greene Engineers, Inc., Spartanburg, S. C., is architect and engineer.

Black River Falls, Wis. — Municipal Electric & Water Utilities will proceed at once with extensions and improvements in municipal power plant, with installation of new diesel engine-generator unit and auxiliary equipment. Mead & Hunt, 550 State St., Madison, Wis., are engineers.

Gresham, Wis. — Municipal Light & Power Dept., plans expansion in municipal power plant, with installation of a new diesel-generating unit and auxiliary equipment.

Menasha, Wis. — Menasha Electric & Water Utilities, 809 Broad St., has been authorized by City Council to carry out expansion in municipal power plant, with installation of a new 7500-kw. turbine-generator, high-pressure boiler and auxiliary equipment. Cost estimated about $1,600,000.

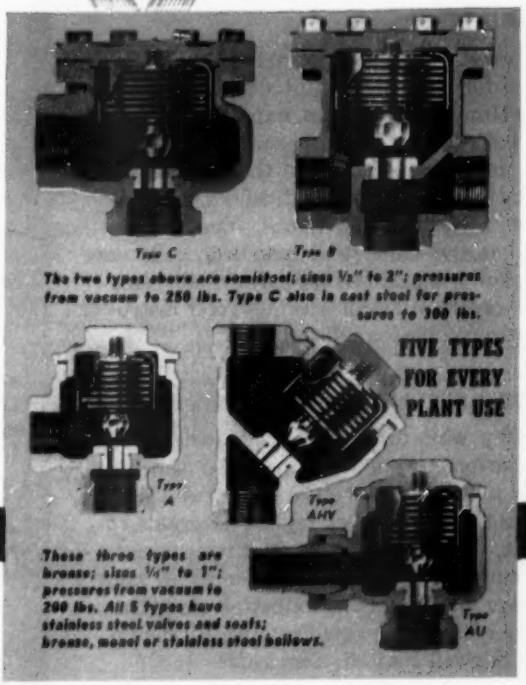


Continental Oil Company's refinery at Denver. Left, Nicholson thermostatic steam traps draining lines to and from a vertical steam turbine. Nicholson units are used almost exclusively.

NICHOLSON TRAPS SELECTED for CONOCO Refinery

This Continental Oil Company refinery has adopted Nicholson steam traps because they proved most effective generally in improving heat transfer. This is an advantage which, we believe, is important to plant men in every industry. A recent survey showed these Nicholson features to be the reasons why plants with standardization-for-economy programs are increasingly adopting Nicholson traps: (1) Two to six times average drainage capacity. (2) Operate at lower temperature differential. (3) No air binding. (4) Freeze-proof. (5) Only one moving part. (6) No change of valves for varying pressures. (7) Record low for steam waste. For process, power, heat.

Send for CATALOG 953


Type C
Type B
The two types above are semisteel; sizes ½" to 2"; pressures from vacuum to 250 lbs. Type C also in cast steel for pressures to 300 lbs.
FIVE TYPES FOR EVERY PLANT USE
Type A
Type AHV
Type AU
These three types are bronze; sizes ¼" to 1"; pressures from vacuum to 200 lbs. All 5 types have stainless steel valves and seats; bronze, monel or stainless steel bellows.

NICHOLSON

TRAPS · VALVES · FLOATS

160 OREGON ST., WILKES-BARRE, PA.

Sales and Engineering Offices in 58 Principal Cities

For more data circle 531 on Post Card

When you need instrument service . . .

Ever have a tire blow out while you're traveling late at night? If it happens near a service station, you're lucky. But if it's on a lonely road far from town, you've got trouble.

When it comes to service on instruments, you don't need to take chances on being lucky. Because when you have Honeywell instruments, you've always got the comfortable feeling that service is close at hand . . . whenever and wherever you want it . . . from the world's biggest instrument service organization.

OVER 110 SERVICE CENTERS

No matter where you may be, there's a Honeywell service man near you. Offices are located in more than 110 cities of the United States and Canada, near every large production center.

When you run into trouble, just telephone or wire the nearest of these offices. You'll get a service specialist promptly . . . often within a few hours. This quick attention to your needs protects your production schedules, and prevents delays that can cause costly stoppages.

TRAINED PERSONNEL

Honeywell service men are thoroughly trained for their important responsibilities. In the Honeywell factories, hand-picked men learn both the theory and practice of instrument maintenance. Then they serve an apprenticeship in the field offices, to gain further first-hand experience. You can be sure that the Honeywell man who calls at your plant is a qualified specialist, well versed in the practical art of keeping good instruments in the best condition.

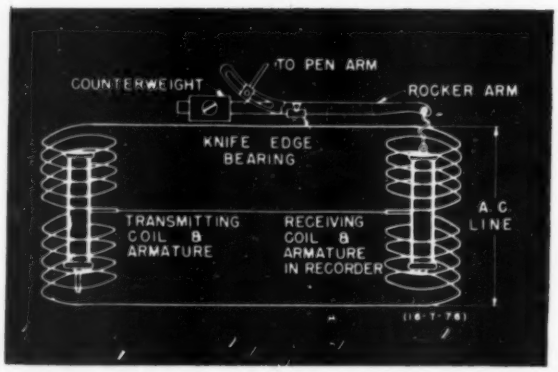
PERIODIC SERVICE

But why wait for emergencies—when you can prevent them with periodic service. Under a simple contract, a Honeywell man will visit your plant at regular intervals to inspect, clean and adjust your instruments and controls. The plan is economical, and can save you hours of production time. Our nearby office will be glad to give full details on Honeywell Periodic Service.

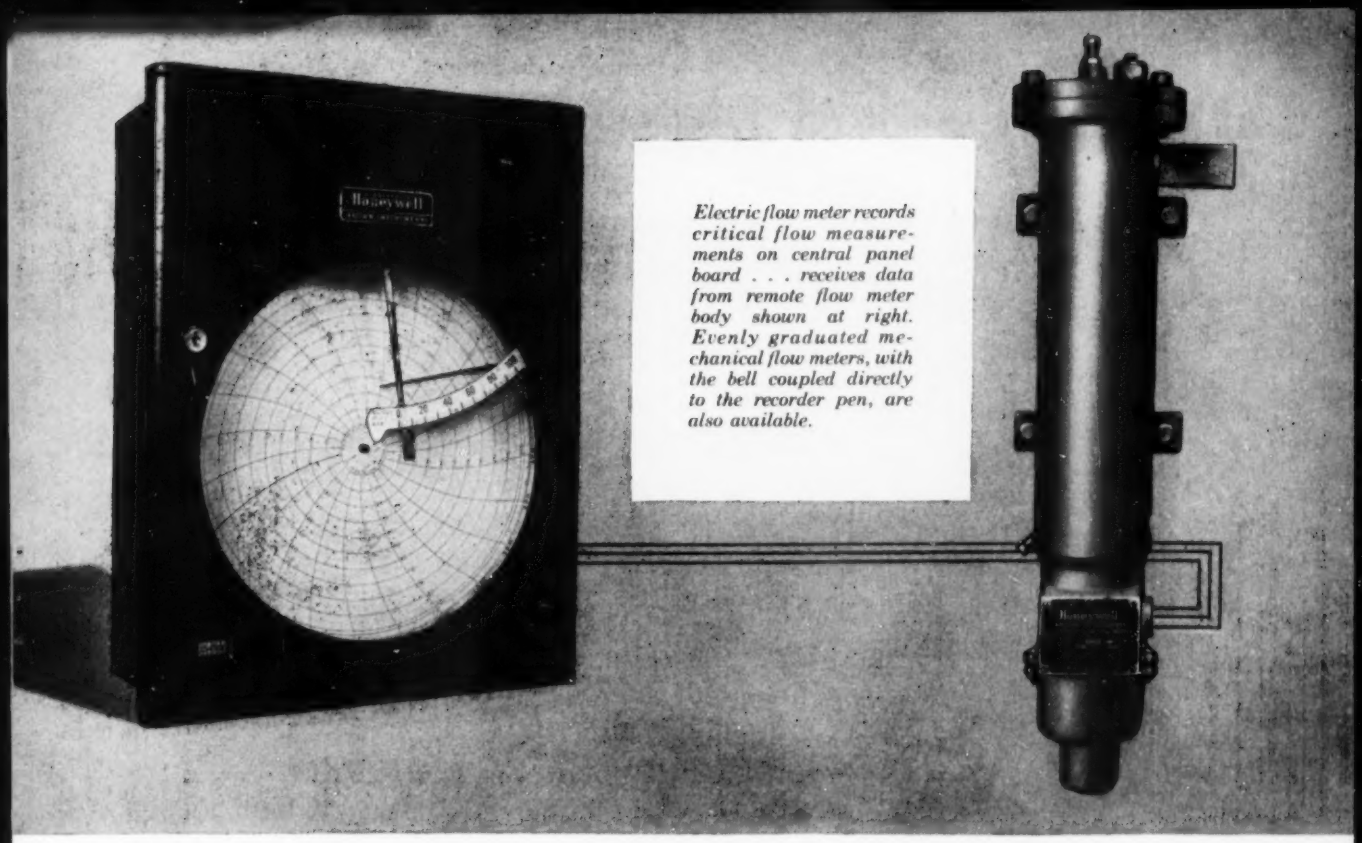
Better accuracy...

greater simplicity

..... *for steam*



ELECTRICAL TRANSMISSION SYSTEM *brings flow data instantaneously and accurately from the remote meter body to the Brown Flow Meter. The inductance bridge system consists of a transmitting coil and armature at the meter body, and an identical coil and armature in the instrument. The receiving armature faithfully duplicates the movement of the transmitter.*



Electric flow meter records critical flow measurements on central panel board . . . receives data from remote flow meter body shown at right. Evenly graduated mechanical flow meters, with the bell coupled directly to the recorder pen, are also available.

plant flow measurements

WHEREVER your steam plant uses measurement of flow . . . for steam, feedwater, make-up water or oil . . . Brown Electric Flow Meters offer every performance feature you could require. Compare these advantages:

Electronic integration . . . using high-speed, high-sensitivity electronic scanning . . . provides exceptional precision in totalizing flow. This unique integrator completely eliminates friction loading of the recording system. It's extremely simple; has only three major parts, and can be calibrated in only a few minutes.

Electrical transmission . . . ideal for centralized control . . . permits the meter body and instrument to be located hundreds of feet apart without loss of sensitivity. A precision-made inductance bridge transmission system (illustrated on the opposite page) gives faithful reproduction of remote measurements, and eliminates the problems of panel pipe connections.

Evenly divided chart assures easy readability and high accuracy at all flow values . . . no crowding of divisions at the low end of the scale.

Brown Electric Flow Meters are available in both square root and evenly graduated type meters with ranges applicable to practically all steam, water and oil measurements. Your nearby Honeywell sales engineer will welcome the opportunity to discuss your specific needs . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Controlling."

MINNEAPOLIS **Honeywell**

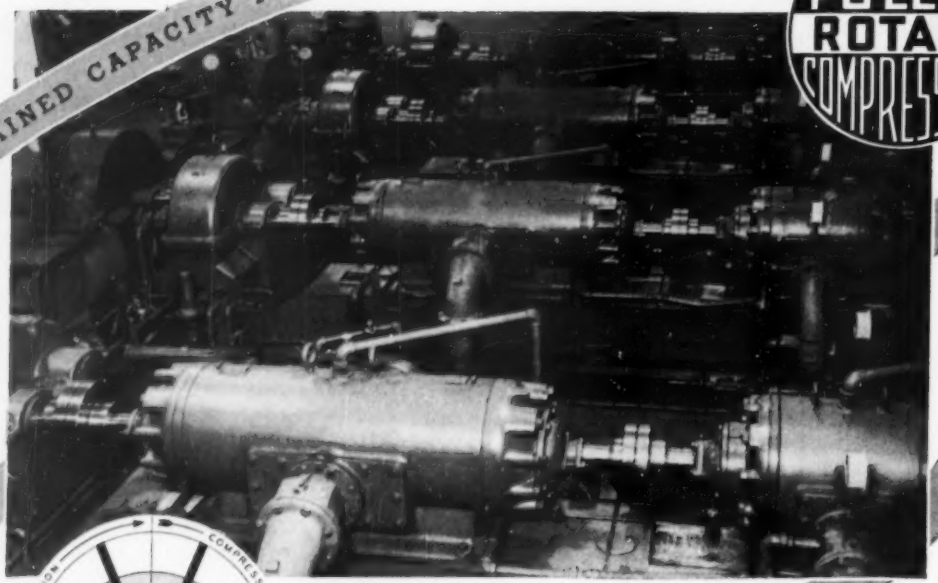
BROWN INSTRUMENTS

First in Controls

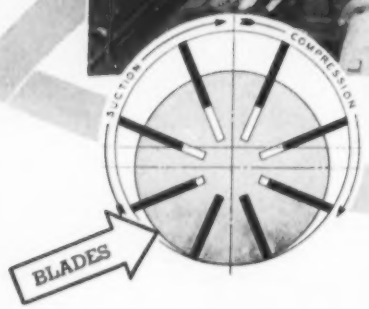
For more data circle 532 on Post Card

MAINTAINED CAPACITY FOR THE LIFE OF THE MACHINE

FULLER ROTARY COMPRESSORS



Four Fuller Rotary Compressors, turbine driven, total capacity 6760 c.f.m., 110-lb. p.s.i.



Due to design and construction, the blades of a Fuller Rotary Compressor automatically compensate for wear, thus eliminating loss of capacity. ***Maintained capacity*** is just one of the many outstanding features of the Fuller Rotary.

The fewer moving parts that make up any piece of equipment, the more continuous service at the lowest operating cost. Fuller Rotary Compressors are an outstanding example of simplicity . . . few moving parts—rotor, bearings, blades.

There is no adjustment of valves, no grinding of seats, no bearing take-up . . . moving parts are reduced to the minimum, all of which means fewer shut-downs, with less costly maintenance charges. Shut-downs are costly . . . lost time can never be recovered. Install Fuller Rotaries for day in and day out, continuous service.

Fullers are built for capacities to 3300 c.f.m. actual free-air delivery, 125-lb. pressure. Write for Bulletin C-6, illustrating and describing the design and construction of this modern compressor.

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St.—Chicago 3
420 Chancery Bldg.—San Francisco 4

Fuller

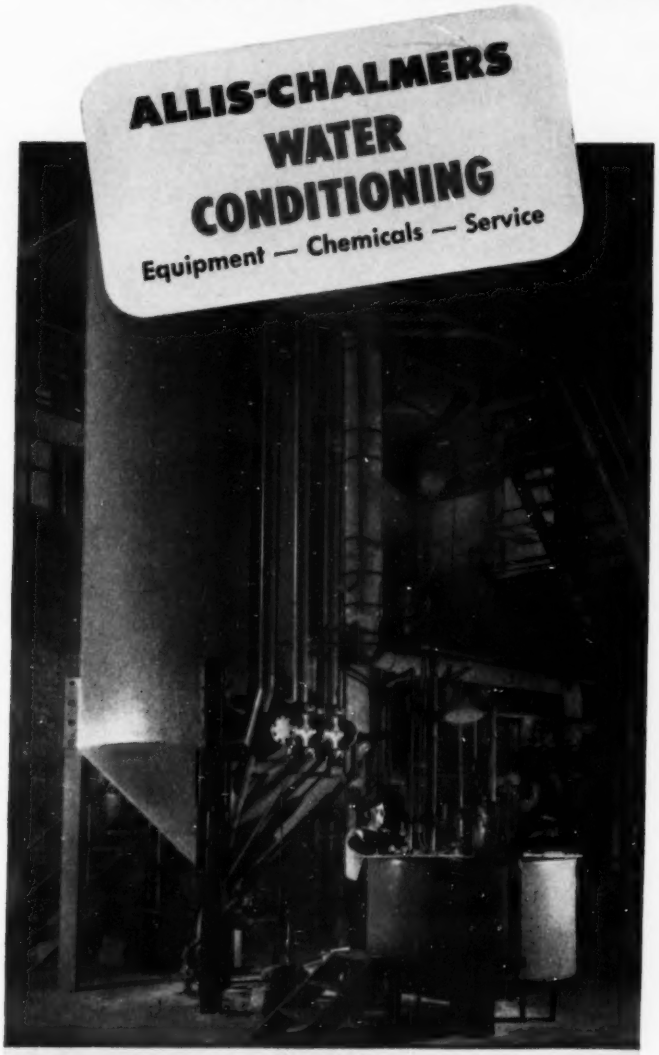
C-229

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

For more data circle 533 on Post Card

Gilbert Paper Co., Menasha, Wis.

Prevents SCALE and CORROSION



Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

To prevent scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

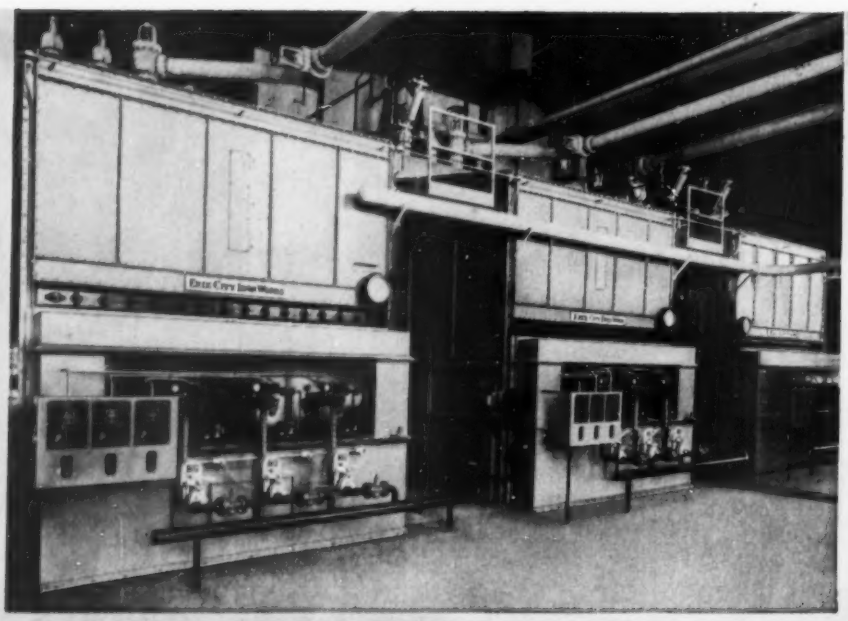
How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

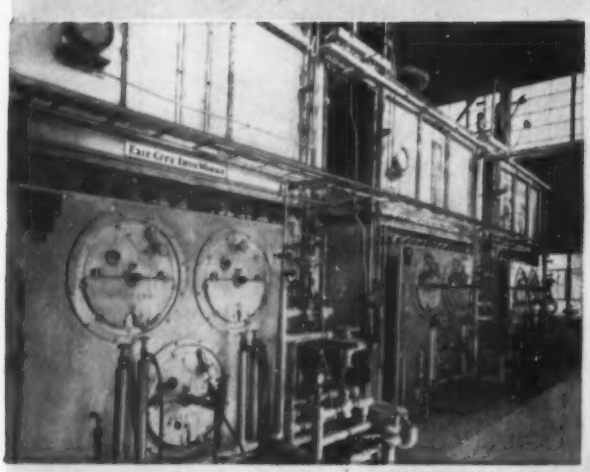
A-4190

ALLIS-CHALMERS

For more data circle 534 on Post Card

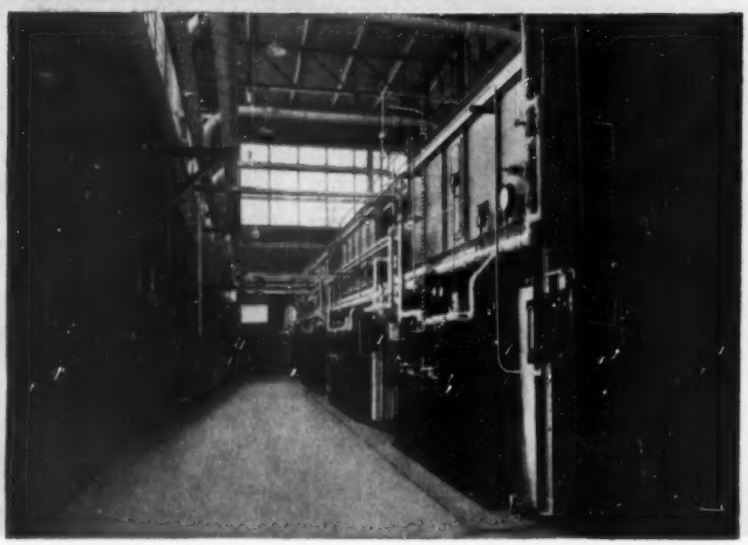


3—Erie City VC's—each 27,000 pounds of steam per hour—oil and gas fired.
A Midwest Capitol Heating Plant

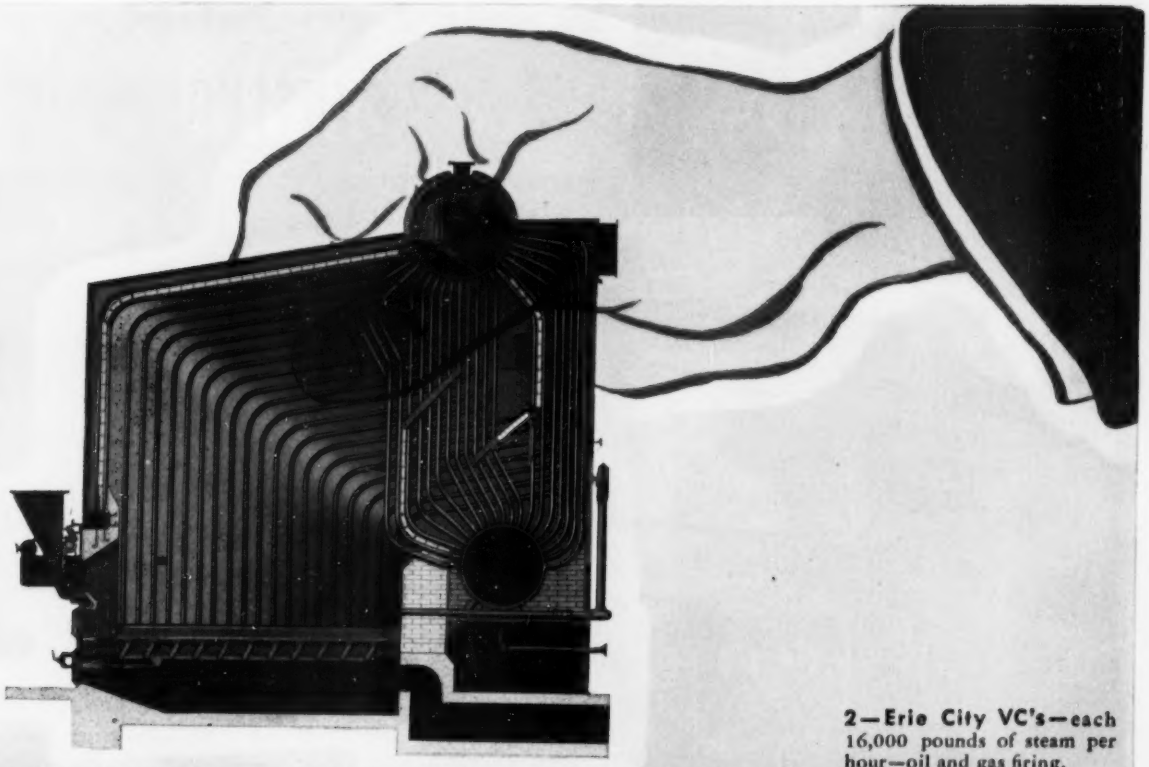


MODERN USE VC's

3—Erie City VC's—each 22,000 pounds of steam per hour—oil and gas fired.
A California Institution

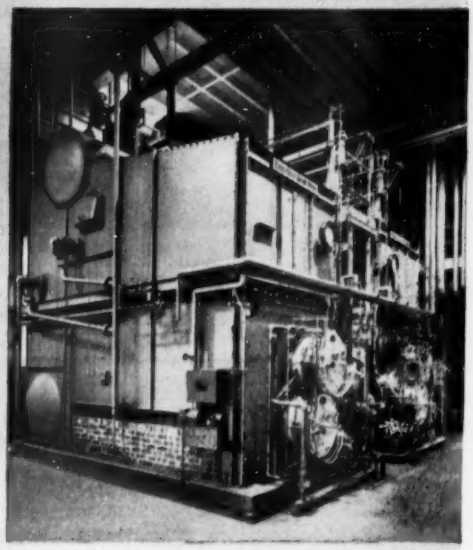


4—Erie City VC's—each 33,000 pounds of steam per hour—oil fired.
U. S. Government



2—Erie City VC's—each 16,000 pounds of steam per hour—oil and gas firing.
● *A California Hospital*

POWER PLANTS FOR *Economy*



● **ECONOMY OF INSTALLATION**
Erie City VC's are built in standard sizes and are compact; utilizing every available cubic foot of space either as furnace volume or as space for heat absorbing tubes.

● **ECONOMY OF MAINTENANCE**
These boilers are completely steel encased, have water cooled furnace walls, and ring flow circulation, giving the user a clean, easily maintained boiler room and eliminating costly refractory repairs.

● **ECONOMY OF OPERATION**
Multiple VC installations insure peak efficiency regardless of load condition. Adaptability to all methods of firing permits use of readily available fuels.

Modernize your power plant with the installation of Erie City VC boilers. Moderate steam users everywhere are finding it economical. Bulletin VC-6 gives a full description of the many advantages of this unit.

You can depend on Erie City for sound engineering

ERIE CITY
114 Years in Steam Generation

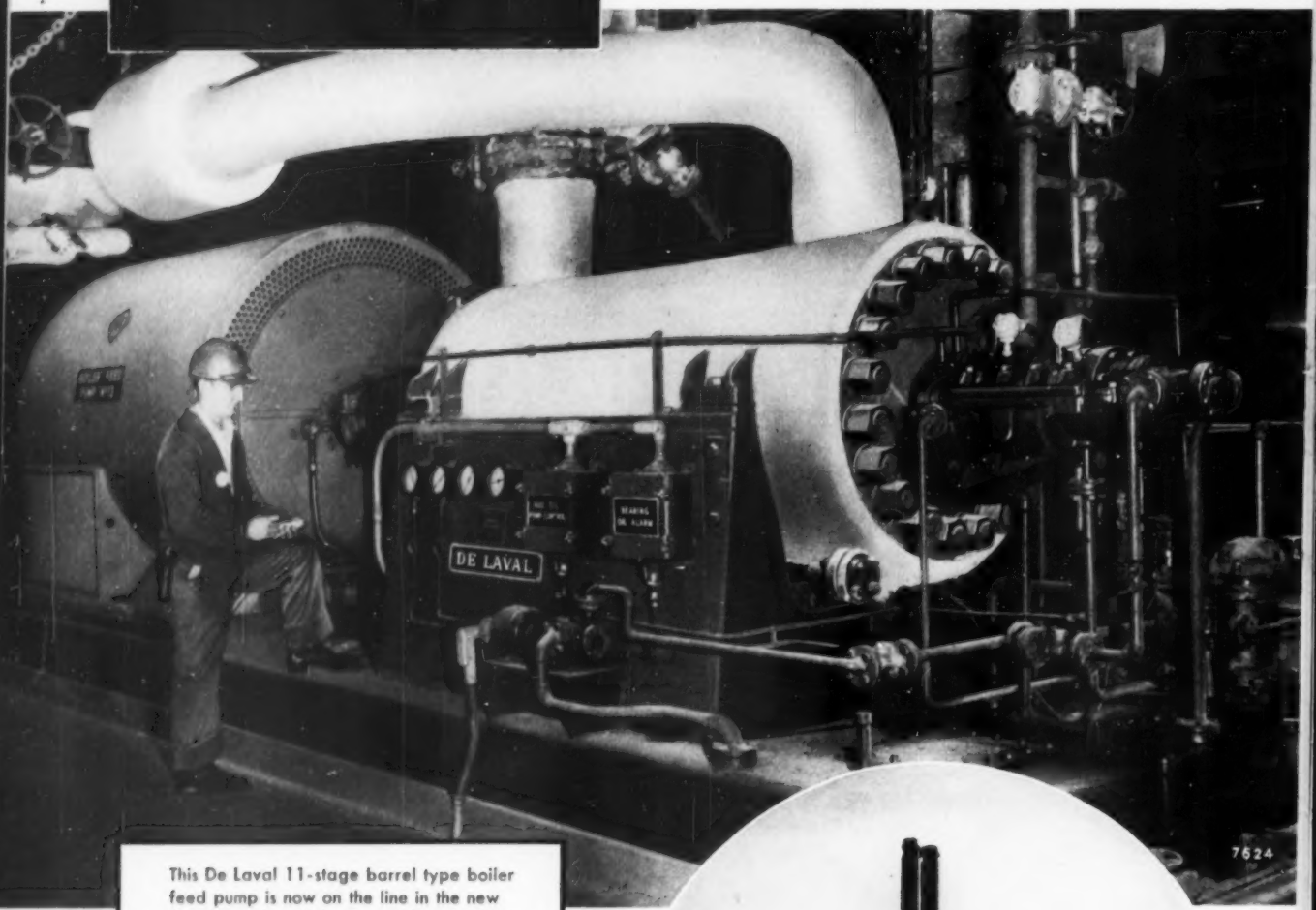
ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

For more data circle 535 on Post Card

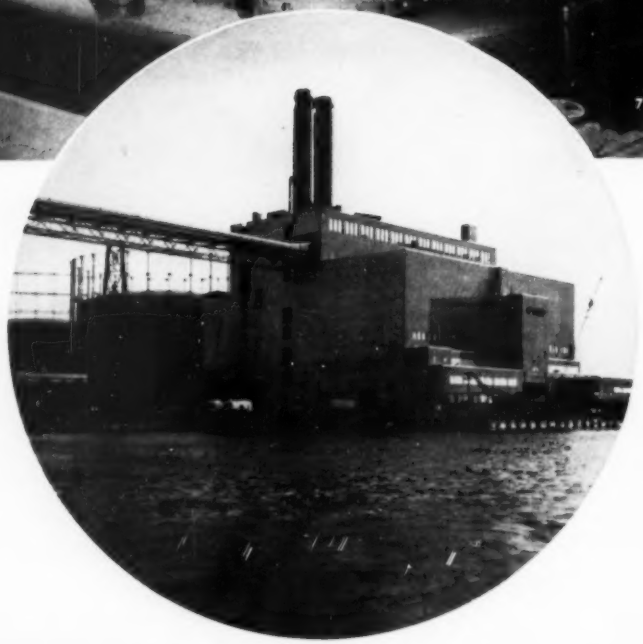
DE LAVAL
BARREL TYPE BOILER FEED PUMP

in new Con Edison *Astoria power station*



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.

The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches. De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.



DE LAVAL *Boiler Feed Pumps*

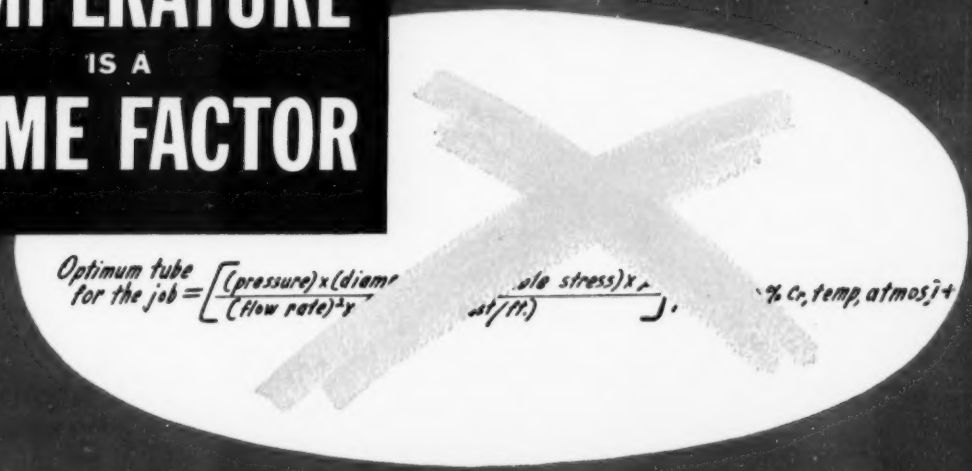
DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL-257

For more data circle 536 on Post Card

WHEN TEMPERATURE IS A PRIME FACTOR



Tube Selection Cannot Be Reduced to a Formula— Even a Complicated One

Many variables are involved in the selection of the optimum tubing for a specific high temperature application. If the tubing is also to operate under high stress, perhaps the most important variable to be considered is mechanical strength.

In general, the mechanical strength of a steel decreases as the temperature increases. Some steels, however, retain more of their strength at elevated temperatures than others. For instance, at 300F, the ultimate strength of both carbon steel and B&W Croloy 18-8 (Type 304) is about 70,000 psi. At 1200F, however, carbon steel is about 12,000 psi while Croloy 18-8 is about 44,000 psi.

To evaluate the characteristics of metals operating under stress at high temperatures and over long periods of time, B&W has performed stress rupture tests and creep tests on a great number of tubing steels.* The results of these tests help engineers to determine the proper tube to be used in specific applications.

Other factors beside mechanical strength, however, must be considered in choosing the optimum tubing for a specific high temperature application. Some of these factors are—oxidation resistance, tube size, tube cost, flow rates, and rates of conductivity and expansion.

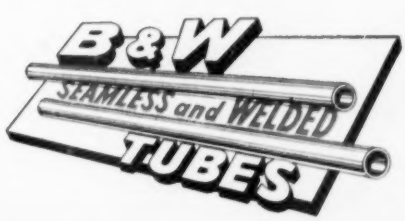
It takes an expert to specify the right tubing for any particular application, and there is no substitute for the kind of experience with these problems you'll find at B&W.

To get the most benefit from B&W's long experience in matching tubes to jobs, call on Mr. Tubes, your nearby B&W Tube Representative. He can help you make the best choice.

Data shown in
TDC 102 Creep Stress Data on B&W Croloys

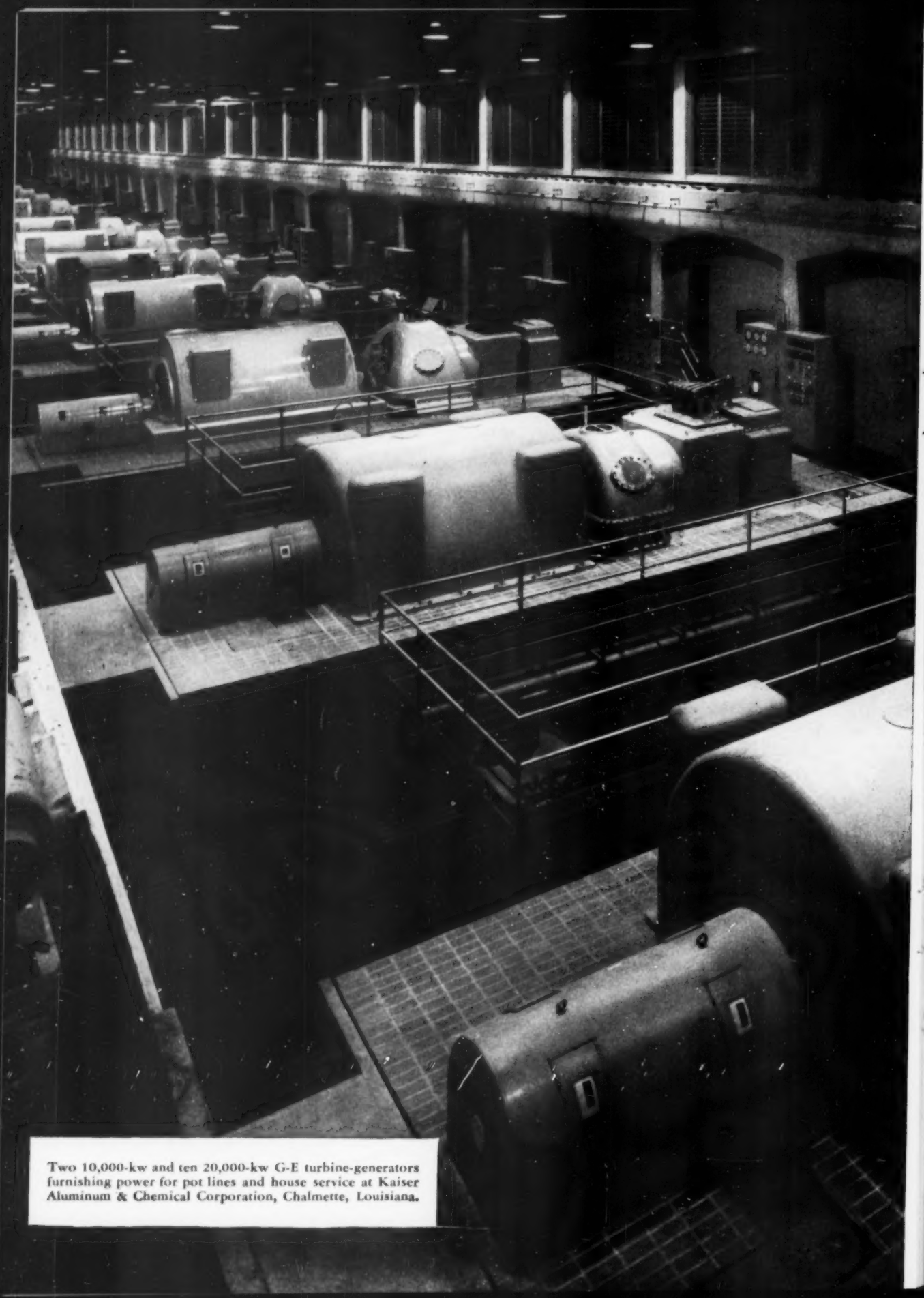
TDC 153 Stress Rupture Data on B&W Croloys available free on request.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

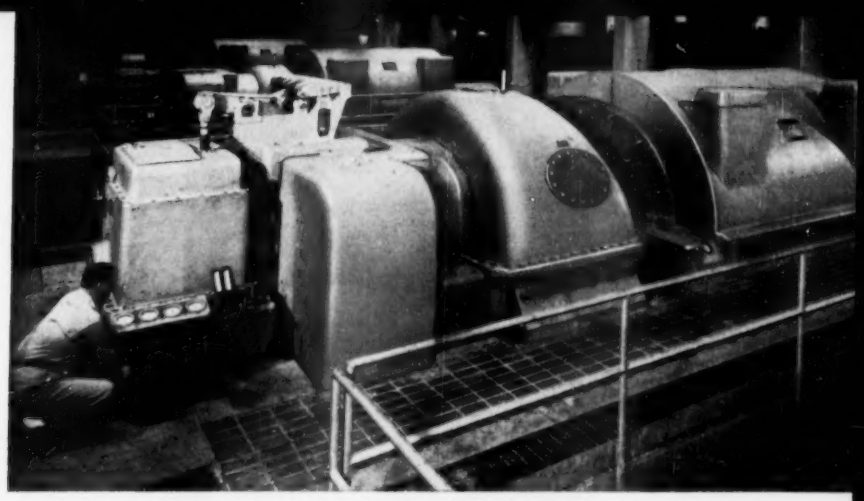


TA-4023 (P)

For more data circle 537 on Post Card



Two 10,000-kw and ten 20,000-kw G-E turbine-generators furnishing power for pot lines and house service at Kaiser Aluminum & Chemical Corporation, Chalmette, Louisiana.



G-E Service Engineer making final inspection of 20,000-kw G-E turbine-generator at Kaiser Aluminum & Chemical Corporation. Two 10,000-kw units in background furnish power for house service.

Kaiser Aluminum Operates Sixteen G-E Turbines in Huge New Plant

KAISER ENGINEERS SELECT G-E TURBINES FOR QUICK DELIVERY; 12 UNITS FURNISH POWER FOR POT LINES; FOUR OTHERS SUPPLY ALL PLANT SERVICES.

When Kaiser Engineers planned the new Kaiser Aluminum and Chemical Corporation plant at Chalmette, Louisiana, they were faced with needing large blocks of power, at specified times, as each pot line was ready to produce aluminum. General Electric turbine-generators were selected, and two 10,000-kw and fourteen 20,000-kw units were ordered because they could be built and installed on time—ready to produce power on schedule.

Six pairs of turbine-generators will deliver 240,000 kw of power to the pot lines. Four other G-E turbines furnish power for all plant services and provide stand-by power.

ENGINEERS WORK TOGETHER

General Electric engineers worked closely with Kaiser Engineers as they do with all companies to achieve over-all project co-ordination on the installation of turbines, switchgear, transformers, rectifiers, etc.

Why not call in G.E.'s experienced engineers to explain the advantages of General Electric equipment in your next turbine installation. If your plant uses quantities of steam, check the economies of G-E automatic-extraction turbines used to supply low-pressure process steam and economical by-product power. Get more for your turbine dollar with G-E turbine-generators. General Electric Co., Schenectady 5, N. Y. 256-6

You can put your confidence in—

GENERAL ELECTRIC

For more data circle 538 on Post Card

new WIDER VISION

for easier remote boiler water level readings

■ Vastly improved visibility of remote boiler water level readings can now be enjoyed by boiler plant operators.

A new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as front of the indicator. Boiler water levels and other liquid levels can be checked from most any position.

Indicating mechanism is operated by the boiler water level itself—assuring instant, accurate readings.

Yarway Indicators are of the manometric type with automatic temperature compensation, as approved for use under the recent A.S.M.E. Boiler Code Committee ruling in Case # 1155.

Over 10,000 are used throughout industry for boiler water and other liquid level indication . . . and for superheater pressure differential indication aboard ship.

For full information write for Bulletin WG-1823.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

A COMPLETE YARWAY SYSTEM

Besides Remote Liquid Level Indicators, Yarway also offers Liquid Level Recorders and Remote Signal Alarms . . . making a complete system for constant, accurate liquid level check.

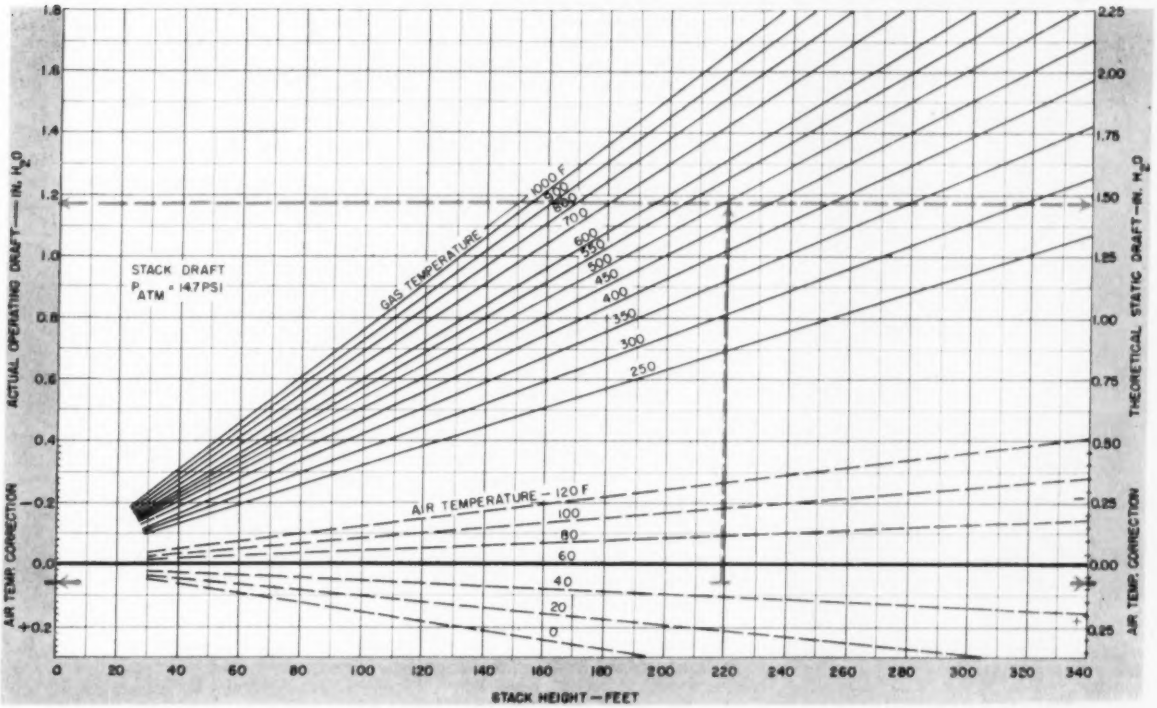
■ Yarway Hi-Lo-Graph Recorder provides not only water level indication, but also a 24-hour recording of water levels. See Yarway Bulletin WG-1830.

■ Yarway Remote Hi-Lo-Alarm Signals—lights or horns—can be placed at any location in plant. See Yarway Bulletin WG-1823.

YARWAY® / remote liquid level indicators

For more data circle 539 on Post Card

Paul J. Grogan's* Graphical Solutions for Power Engineers



Graph for the solution of actual and theoretical stack draft, assuming 14.7 psia atmospheric pressure and actual draft being 80 per cent of the theoretical

Figuring Natural Chimney Draft

BEFORE the general advent of forced and induced draft fans in power plants, the subject of chimney draft received considerable theoretical study. Among the formulae developed to express theoretical chimney draft, the one given in Kent's Mechanical Engineers' Handbook stands out. It is:

$$MTSD = 7.6\ H\left(\frac{1}{T_{air}} - \frac{1}{T_{gas}}\right)$$

in which MTSD = mean theoretical static draft (in. H_2O), H = height of chimney (ft), and T = absolute temperature (degrees Rankine). The above equation is based on an atmospheric pressure of 14.7 psia.

In the graphical solution presented here, and constructed from this equation, an initial assumption is made that the outside air temperature is 60 F. To accommodate this assumption, the MTSD equation is rewritten:

$$MTSD = \frac{7.6\ H\ (T_{gas} - 520)}{T_{gas} \times 520}$$

It can be seen from this that chimney draft may be represented as a straight-line function of height and various assumed gas temperatures.

To accommodate the difference between theoretical and actual operating draft, we assumed a factor of 0.8 — that is, actual operating draft will be 80 per cent of the theoretical draft. This compensates for both inertia and friction of gas flow and must, therefore, be related to gas velocity. In this construction, gas velocity is assumed to be 30 fps, which will result in an average "friction factor" of 0.8.

Changes in atmospheric and flue gas temperatures have a pronounced effect on natural draft. For example, a *drop* in outside air temperature from 100 F to 0 F will cause about the same increase in draft as an *increase* of flue gas temperature from 500 F to 1000 F.

Dotted lines represent ambient temperatures on the graph and range above and below the assumed average of 60 F. The starting points for all calculations on this graph are at the intersection of chimney height and ambient temperature. If that point falls *below* the 60 F line, *add* the air temperature correction factor to the draft. If it falls *above* the 60 F line, *subtract* the noted temperature correction factor from the draft.

Variations in atmospheric pressure, from the assumed 14.7 psia, will have an effect on chimney draft, but the effect is negligible.

Example: — Assume a 220-ft stack with ambient (outside air) and flue gas temperatures of 50 F and 500 F respectively. Enter the graph at 220 ft on the abscissa and project a line upward to intersect the 50 F line (midway between the 40 F and 60 F lines). From this point, project lines horizontally to the left- and right-hand ordinates. The point of intersection at the left is the correction factor (plus 0.05 in. H_2O) for the actual operating draft. The intersection at the right (plus 0.06 in H_2O) is the correction factor for theoretical static draft. Return to the intersection of chimney height and ambient temperature and project a line vertically to the 500 F gas temperature line. From that intersection, project lines horizontally left and right to the ordinates to obtain the actual and theoretical drafts (1.19 and 1.49 respectively). To these are *added* (in this case) their correction factors:

Actual Operating Draft = 1.19 + 0.05 = 1.24 in. H_2O

Mean Theoretical Stack Draft = 1.49 + 0.06 = 1.55 in. H_2O

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* Chairman, Department of Engineering, and Director of Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.

Fig. 1. Measuring transformer noise in the field. Data is recorded on magnetic tape. Later on, in the laboratory, it will be played back for analysis

How Much Noise Does Your Plant Make?

For years noise measurement was largely a matter of guesswork. Now new techniques, described here, give an accurate diagnosis of plant noise troubles

By H. C. HARDY

Assistant Chairman, Physics Research Dept., Armour Research Foundation.

NOISE REDUCTION engineering differs considerably from the usual engineering because it requires a deeper knowledge of ordinary physical phenomena and an understanding of the subjective reaction of people to noise. Because of this subjective reaction, and because there is very little training in acoustics in engineering courses, many noise problems have grown unchecked. In the past, there has been more judicious guesswork than science in dealing with noise. However, the situation is changing, and this article describes how acoustical engineers now set about the job of finding out which equipment makes objectionable noise and what can be done to cure it.

Power plant noise can be divided into two classes: 1. Noise that affects plant personnel, and 2. Noise that is transmitted outside the plant and annoys residents in the neighborhood. The following discussion applies to this second class only.

Analyzing the Problem

When analyzing a noise problem, the following steps are necessary:

1. Determine how much noise will be acceptable in the neighborhood of the plant.

2. Determine what noise sources exist.

3. Measure the total sound power radiated by each source as a function of frequency.

4. Determine the total intensity that will arrive at the nearest houses, allowing for ground, meteorological conditions, and other factors that will modify the radiated noise.

5. The difference between 4 and 1 gives the amount by which the noise has to be reduced.

6. The next step is to reduce the noise by this amount as cheaply as possible. It may be reduced at the source, or by construction that will absorb or prevent the radiated noise reaching the complainants. This method of attack will be illustrated by an example from one of many such problems that are being solved by the Acoustics and Vibrations staff of the Armour Research Foundation.

Consider the case of a large open air power plant built about a quarter of a mile from a very quiet residential neighborhood. Noise complaints came in to the plant management, and it was obvious just by listening that the noise came from the plant and that it was objectionable.

Observations near the plant indicated that there was more than one noise source; in fact, there were several of them. These were 1. The turbines, which were only partially enclosed, 2. The power distribution area where there were many noisy transformers, and 3. The noise of the fuel burning system, which could be broken down into three parts: (a) the forced draft fans, (b) combustion noise in the burners, and (c) induced draft fans, with possibly a control valve near the stack. The noise from all these emanated in some degree from the intake end, the side walls of several large breeching ducts, and from the top of the stack. The problem was to determine which of these sources were the most important, which had to be treated, and how to treat them.

Measuring the Noise

Ordinary sound level meter measurements are practically useless in analyzing the problem. In the first place, the sound level meter gives only a measurement of sound pressure, whatever the frequency of the noise. But the ear registers different loudness sensations for different frequencies, even though the sound pressure is the same all the time. So if an instrument is going to measure what the ear hears, it must take into account the frequency of the noise. This is best done by an instrument called an octave-band filter analyzer, which measures the pressure at different frequency bands. The frequency ranges covered by commercial band-pass filters are 37.5 – 75, 75 – 150, 150 – 300, 300 – 600, 600 – 1200, 1200 – 2400, 2400 – 4800, and 4800 – 9600 cycles per sec. The instrument is set for each of these frequency bands by pushing a button or turning a step switch. Details of this method were given in the February 1954 issue of POWER ENGINEERING.

The second reason why a spot sound pressure level measurement does not give a complete picture is that it measures the sound intensity only, i.e. the sound per unit area passing the microphone. To determine the amount of sound at a distance, it is necessary to take into account the size of the sound source, and multiply the intensity by the area covered by the sound source. By doing this the proper relation can be kept between small and large sound sources.

When taking into account the size of the source we use the concept of power level. All sound sources are calculated as if all the sound were radiated from a point source. The power level is the sound pressure level on the surface of a sphere of one-square-foot area with all the sound power concentrated as if it radiated from the centre of the sphere. Knowing the various power levels we can compute the sound pressure level at any distance from each source by using the inverse square law. Since point sources of noise are very few, we have to make corrections for the beaming, or concentrating effect of the shape of the source; a source with a large area in one direction will beam more noise in the direction this large area is facing, and point source calculations have to be corrected to allow for this beaming effect.

In Table 1 is summarized, for the plant we are considering, the

contribution of the various sound sources to the total sound pressure level at a distance of 1200 ft. The noise from the transformers was found to be insignificant. The data in Table 1 is given for the 150–300 cps frequency band, since, as the analysis presented below will show, this was the frequency band that made most noise.

It will be noticed that close to the sources the order of loudness was A, C, D, B; whereas at long distances the order changed to B, A, D, C. and that this change was mainly due to the effect of area and beaming on the sound pressure level at a distance from the source. The contribution of the breeching ducts at a distance was chiefly due to their large radiating area. The total sound pressure level of all sources would be 45 decibels.

The measured sound level at a distance ranged between 40 and 52 db in the 150–300 cps band, depending on wind conditions, the average being about 46 db. At close distances, around 300 ft, the measured values agreed more closely with the computed figures, because there was less wind effect.

The level at the top of the stack was not measured, but was estimated from measurements at the bottom of the stack when a small door in the stack was opened.

In Fig. 2 are plotted some of the octave band data measured at the plant and in its vicinity. It will be noticed that the shape of the spectrum near the breeching duct is very similar to the shape of the spectrum at 300 ft, if we allow for the fact that the high frequencies are attenuated more rapidly than the inverse square law due to air and ground absorption.

Table I. Contribution of various sound sources to total sound pressure level at distance of 1200 ft

(Computations for 150–300 cups band)

SOURCE	Sound Pressure Level (db)		Approx. radiating area (sq ft)	Area[4] Correction (db)	Power Level (db)	Inverse Square Law 1200 ft (db)[5]	Beaming Correction (db)	SPL at 1200 ft (db)
	Measured	Computed at Source						
A. Forced Draft Fans	92	100[2]	140	21	121	−73	−12[6]	36
B. Breeching Ducts	76	80[3]	10000	40	120	−73	−3[7]	44
C. Top of Stack	90[1]	90[1]	110	20	110	−73	−8[8]	29
D. Low Pressure Turbines	84	90[1]	2000[1]	33	123	−73	−15[9]	35

[1]Approximate.
[2]92 db 10 ft away computed to be 100 db in opening of fans.
[3]76 db 22 ft from breeching ducts, computed to be 80 db at surface of ducts.
[4]10 log A, A = area in sq ft.
[5]$20 \log \frac{D}{0.28} = 11 + 20 \log D$, D = 1200 feet, 11 + 20 log 1200 = 73.
[6]Forced draft fans are behind 10 ft wall.
[7]Breeching ducts beam sound upward slightly.
[8]Stack beams sound upward.
[9]Large beaming of plant structure in a direction 90 deg from residential area.

The 300 ft cross-wind data are shown in this figure because they are much less erratic than the data at larger distances or downwind from the plant. The cross-wind measurements can provide a before-and-after test of the effectiveness of the acoustic measures taken to reduce the noise.

From the measurements taken at various points, one could estimate rather accurately the noise spectra inside the breeching ducts and stack. This data is given in Fig. 3. Curve D gives data taken just below the breeching duct. Close to the wall of the duct the curve would be C. Data on the sound transmission loss of the walls of the duct can be obtained, and when this is added, the spectrum inside the ducts is given in A. This is almost a flat spectrum as plotted in octave bands, which is what would be expected of aerodynamic noise. Curve B gives the noise at the base of the stack after it has been attenuated by several turns and bends. The noise at the top of the stack is slightly less intense than this.

Curve E, the design goal on the ground, is the amount the sound must be lowered near the source to give satisfactory results at the residences 1200 ft away. The way this curve is obtained is given in the next section.

Loudness and Design Goal

The sound spectra plotted in Fig. 2 and 3 do not weight the frequencies the same way the ear does. The proper frequency weighting is done by the graph paper shown in Fig. 4. The middle curve on this figure is the sound heard 300 feet downwind, the spread of data being chiefly due to the wind.

The graph paper shown here was developed at the Armour Research Foundation[1,2], and it actually plots the loudness curve of the noise. The psychological unit of loudness

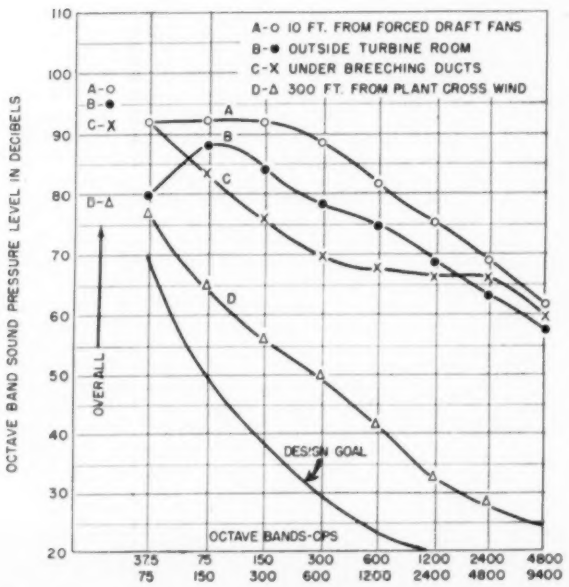

A-○ 10 FT. FROM FORCED DRAFT FANS
B-● OUTSIDE TURBINE ROOM
C-X UNDER BREECHING DUCTS
D-Δ 300 FT. FROM PLANT CROSS WIND
OCTAVE BAND SOUND PRESSURE LEVEL IN DECIBELS
OVERALL
DESIGN GOAL
OCTAVE BANDS-CPS
75 150 300 600 1200 2400 4800 9400

Fig. 2. Power plant noise values at various points showing reduction required

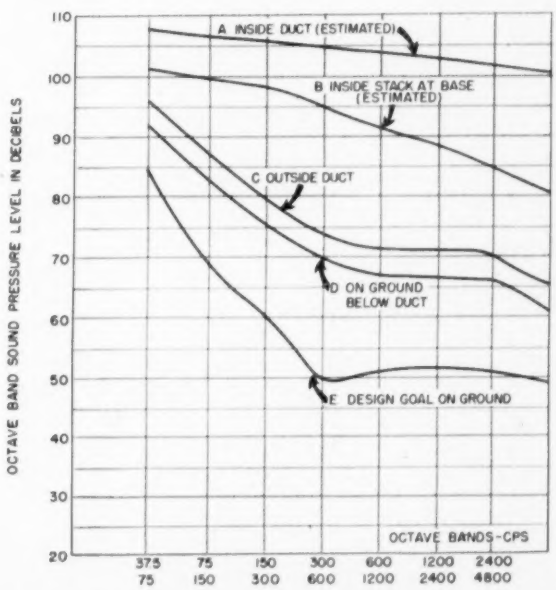

A INSIDE DUCT (ESTIMATED)
B INSIDE STACK AT BASE (ESTIMATED)
C OUTSIDE DUCT
D ON GROUND BELOW DUCT
E DESIGN GOAL ON GROUND
OCTAVE BAND SOUND PRESSURE LEVEL IN DECIBELS
OCTAVE BANDS-CPS
75 150 300 600 1200 2400 4800

Fig. 3. Breeching duct noise at various positions showing reduction required

Table II. Shows noise reduction required for the breeching duct to bring it below allowable maximum

Octave Band	37.5-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-9600
Decibels	7	15	17	20	17	13	13	0

is the Sone. This unit is an arithmetic one such that 40 sones is five times as loud as eight sones, and eight sones twice as loud as four sones, etc. The loudness of most home appliances is about one sone, a passing auto is 15 sones, a heavy truck 60 sones. In the very low ambient noise level of the residential section discussed in this paper, one to two sones might be considered the maximum loudness which would be acceptable at night.

There are other uses for the graph paper of Fig. 4 as well as showing the octave bands which contribute the most loudness. One can get total loudness by adding the contributions of each octave band. The figures in the first column show the total loudness in sones. At 300 feet the loudness varies from moment to moment from 12 to 19 sones or 60 per cent. At 1200 feet, the loudness varies from 1 to 5 sones or 500 per cent. The large variation is the main cause of the annoyance.

As it may be of interest, the loudness curve of one of the loudest areas in the plant, that near the forced draft fans, is also plotted in Fig. 4.

Observations in the residential area indicate that the lower loudness curve for the 1200 ft downwind data would be entirely acceptable even at night. The acceptable level curve is given as the heavy line in Fig. 4. The total loudness of a spectrum of this shape is 1.4 sones.

The amount of quieting needed is found by subtracting the acceptable level curve from the upper limit of the 1200 ft downwind curve. 5 db more is added to this to take care of unfavorable meteorological conditions which may not have been observed in the previous tests.

The resulting quieting needed for the breeching ducts is given in Table II.

The design goal plotted in Figs. 2 and 3 is obtained by subtracting these figures from the curves previously described.

It will be noticed that if this amount of reduction is applied to the breeching ducts alone the noise from the forced draft fans and the lower pressure turbines will be audible. About 10 db reduction is needed for each of these units.

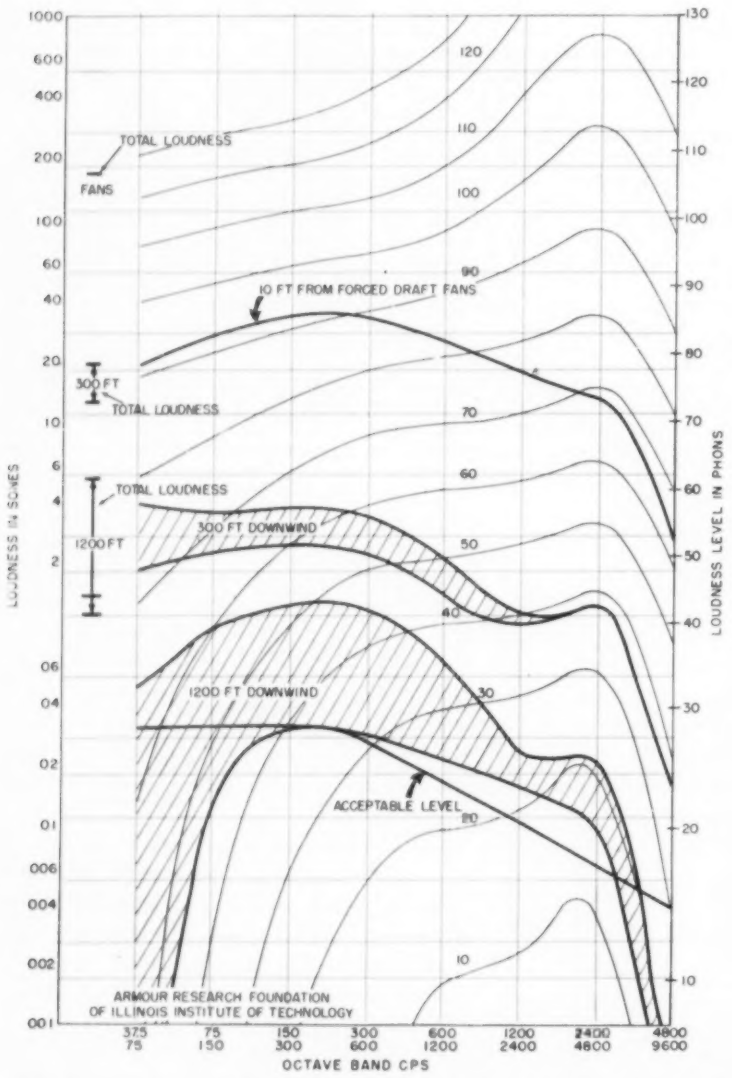


Fig. 4. Loudness curves for noise of power plant which had received complaints of excessive noise. The construction and application of this chart were explained in the February issue of POWER ENGINEERING

Reducing Noise

Reducing the noise of the breeching ducts 15–20 db can be done by three methods:

1. Put the ducts underground, with the exposed section covered by another thin partition.
2. Build a new duct wall completely around the ducts which is vibration isolated from the present duct and duct supports.
3. Install acoustical absorbing baffles in the duct and, in addition, build a high sound reflecting wall between ducts and residential area.

To reduce the noise of the forced draft fans 10 decibels in the octave bands in which reduction is needed, required the installation of an air intake duct with a 180 deg bend lined with acoustical material.

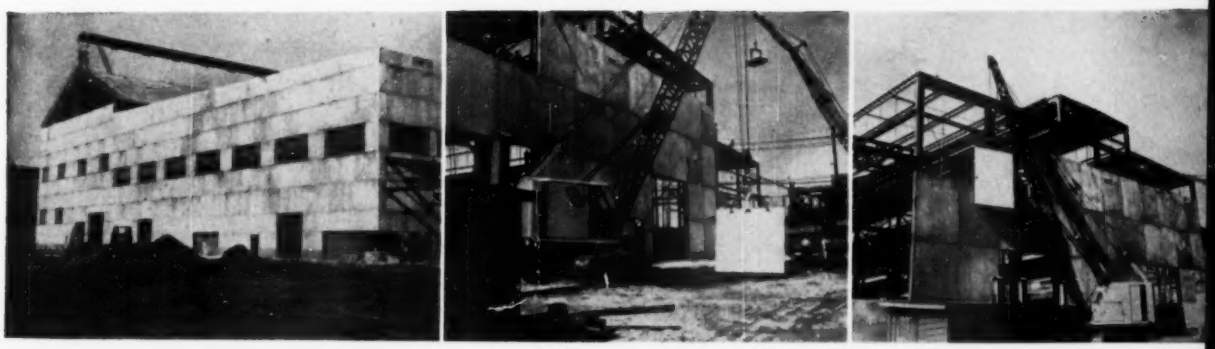
To reduce the noise of the turbine room 10 decibels in the octave band needed, required closing the windows and doors of the turbine room and ventilating the room by acoustically lined ducts.

In each of the cases, costs were kept low by doing no more than was necessary to fulfill the design requirements given above.

A great deal of the success of the methods described here depends on making the proper noise measurements as a function of frequency and using the correct techniques to evaluate these data. It is hoped that the techniques given above will enable plant engineers to attack outdoor noise nuisance problems more objectively and accurately.

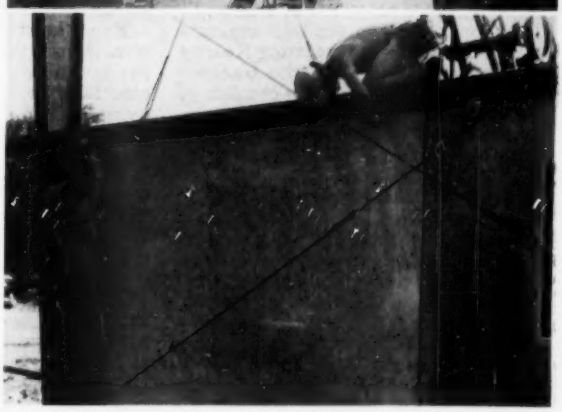
[1] D. B. Callaway, *Proceedings of the Second National Noise Abatement Symposium*, Armour Research Foundation of Illinois Institute of Technology, p. 64–74, (Oct. 1951).

[2] F. Mintz and F. G. Tyzzer, "Loudness Chart for Octave-Band Data on Complex Sounds," Jour. Acoust. Soc. Am. *24*, 80–82, (Jan. 52)



Illustrations above show how precast concrete panel construction combines architectural beauty with low cost. Outside appearance of finished building resembles Indiana limestone. Assembly is very rapid; the building shown above, which is 660 ft long, 275 ft wide and 70 ft high, took only two months to build. Panels, which are insulated, come in various sizes. A 5-in. thick panel has an insulation value which is equivalent to an ordinary 12-in. thick masonry wall

Stages in the assembly of a building using 10 ft by 8 ft by 5-in. thick precast concrete panels are shown on the right. Panels have cast-in metal inserts for bolting to building steel, and by placing the erecting crane in a suitable position the panels can be lifted straight off the truck and set in place on the building without any intermediate handling, unloading or storage at building site



Precast Panels Speed Construction of Utility Buildings

For building large, well insulated, low-cost buildings very quickly, these precast insulated concrete panels are hard to beat

PRECAST PANEL construction shown here combines architectural beauty with low erection cost. In appearance the exterior surface of the building resembles Indiana limestone, and the inside walls have a muslin finish. The panels are 8 ft by 10 ft and each consists of a 5-in. thick sandwich of two layers of concrete, each about 1¾ thick, with a core of 1½ in. of insulating material between them. This panel insulation gives a 5-in. thick panel the insulation value of a 12 in. masonry wall.

Readers may remember that we first mentioned these precast panels in the July issue of POWER ENGINEERING when describing the great new Marietta plant of Electro Metallurgical Co., where this type of construction was used for the exterior walls of the power plant and factory buildings.

For more information write to the Editor or use one of the prepaid postcards elsewhere in this issue. Write PRECAST PANELS on postcard and mail to us

Kearny Nos. 7 & 8

Fig. 2. Kearny Station today. The new units are seen at the right

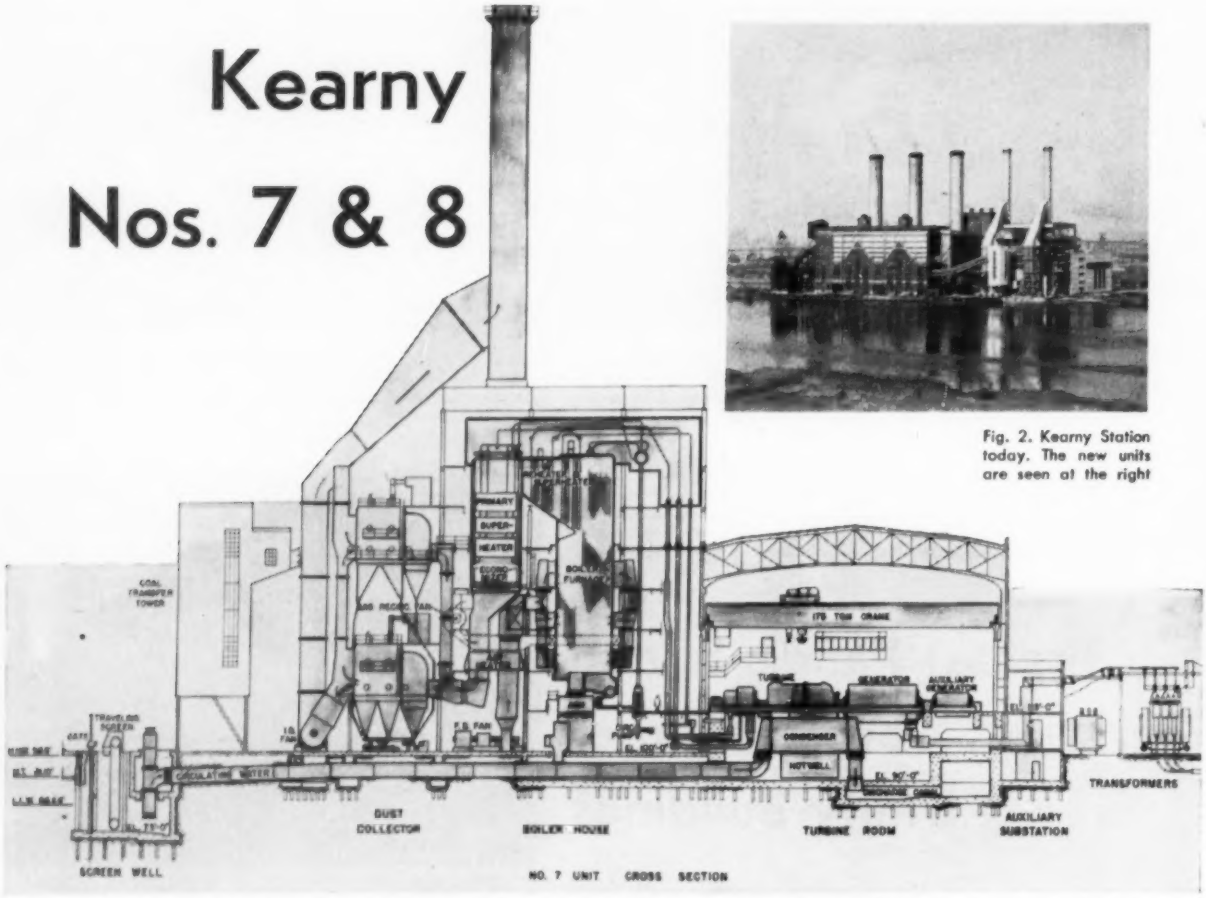


Fig. 1. Cross-section through Kearny Station at the new Unit No. 7. Both units use 2350-psig, 1100-F steam from a 955 M lb/hr controlled circulation boiler

Famous station of the Public Service Electric & Gas Company has two new 145,000-kw, 2350-psi. 1100-F/1050-F reheat turbine generators; controlled-circulation, pressurized, outdoor boilers; gas recirculation; side-exhaust turbines; heat rate 8830 Btu per kwh

AS NOTED in our March issue, Editor Andrew W. Kramer attended the press party on January 27, 1954, at the new addition to Kearny Generating Station of Public Service Gas & Electric Co. This addition consists of an entirely separate plant adjacent to the existing Kearny Station on the bank of the Hackensack River. The extension consists of two 145,000-kw turbine generators, each served with steam at 2350 psi, 1100 F by a 1,055,000-lb-per-hr steam generating unit.

The new Kearny units form the latest item in a continuous program of generating plant development carried on by the company since 1947. To meet the tremendous load growth in the area covered by its system, in 1947 it put into operation a 110,000-kw, 3600-rpm 1000-F unit at its Essex Generating Station. Many of its unusual features were incorporated in the design of its next installation at Sewaren, where the first two units, of 110,000-kw capacity but for 1050 F steam, were put into operation in 1949 (See POWER ENGINEERING, July 1949 issue). Two additional units were installed in 1951.

Even before these last machines were in service, plans were started for the new Kearny units shown here. To care for future growth, construction work is well under way for a new 185,000-kw unit at Burlington Generating Station for 1955 and on order is an even larger unit to be put in service late in 1956.

Details of the new Kearny units, Nos. 7 & 8, including a complete list of equipment, were given at the annual ASME meeting last December in Paper No. 53-A-71 by F. P. Fairchild, chief engineer, electrical engineering department, Public Service Electric & Gas Co. In that paper, considerable space was devoted to the significant differences between the new Kearny Station and the recently-completed Sewaren Station.

This new Kearny station has, for its principal equipment, two turbine generators and two boilers arranged in the unit system. The entire plant is operated from a control room on the operating floor at the center of the square formed by the four major items of equipment. The new units are operated as a separate station with practically no ties, electrically or mechanically, with the old station. Boilers are close to turbines, hence steam leads are short. Coal pulverizers are placed alongside and between the boilers and are enclosed in a separate ventilated room.

Feed water heating cycle, Fig. 4, includes eight stages of heating with six heaters per unit before the boiler feed pumps. At full load, the pumping temperature is 395 F. To provide a cold-water emergency supply for the feed pumps, in the event of the loss of a condensate-booster pump, one electrical feed for each set of pumps has been provided, with the result that a failure of either pump stops both the condensate-booster pump and its associated boiler feed pump, leaving the remaining set of pumps operating.

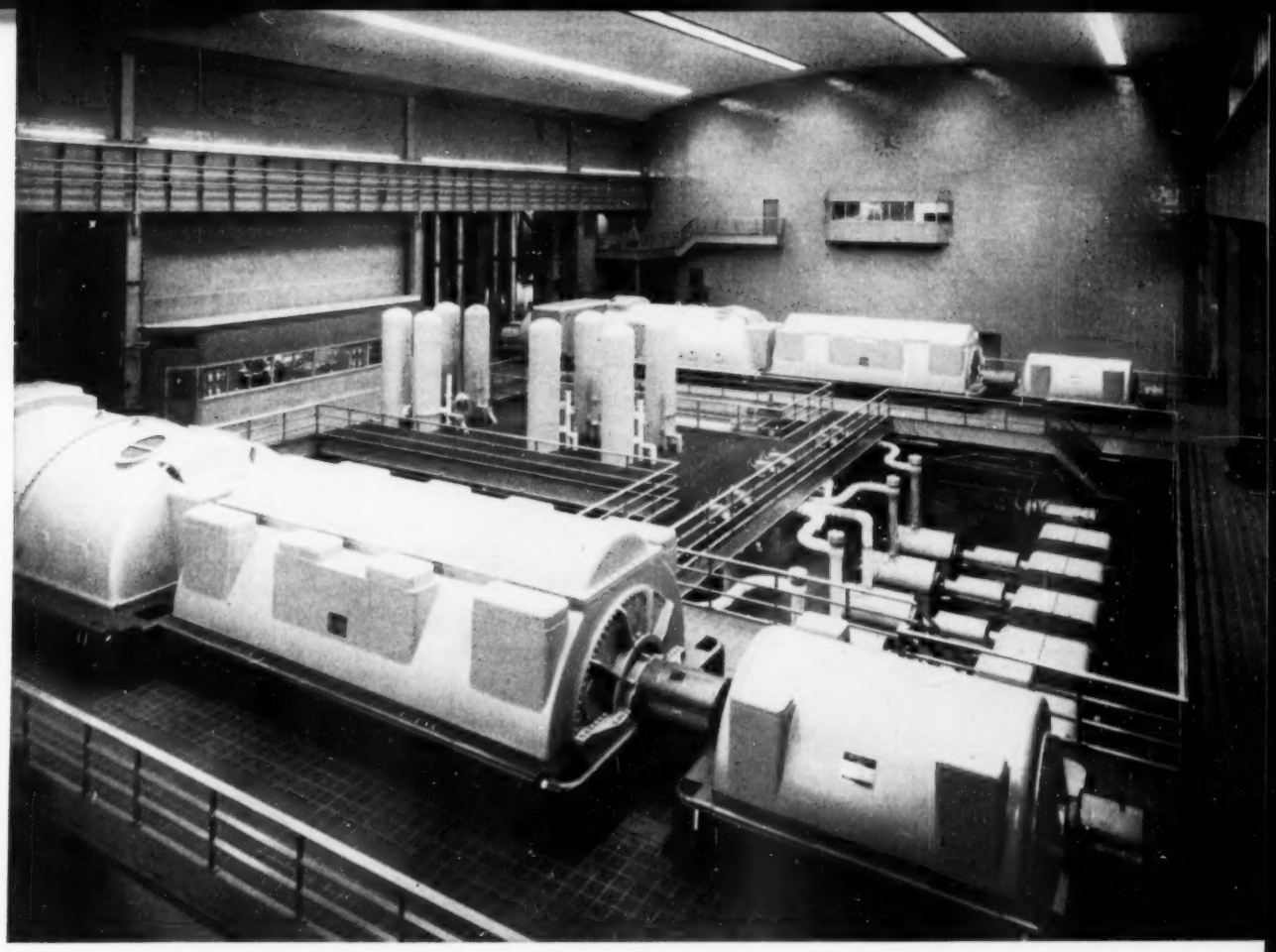


Fig. 3. New units Nos. 7 & 8, each rated 145,000 kw, are tandem compound type, triple flow reheat turbines; boiler feed pumps are at right between units

Unusual features of the new Kearny boilers include controlled circulation, pressurized firing, twin furnaces, flue-gas recirculation, and higher steam temperatures and pressures. These boilers have divided furnaces of continuous-discharge, wet-bottom type. They are equipped to burn either coal or oil. Each twin furnace is about 20 ft square. The dividing waterwall has large openings to equalize furnace pressure.

High-temperature stage of the superheater, which is located at the exit of the furnace, has its pendant tubes arranged in platens widely spaced to take advantage of radiant heat and to reduce fouling. The reheater, which also has pendant tubes but not in platens, follows the high-temperature superheater in the gas path. In the downward pass, the gases flow over the primary superheater, then the economizer and finally the Ljungstrom air heaters. At this point the flow splits as it enters the two decks of the flue-dust collectors, which are of the combined mechanical-electrostatic type. These collectors are equipped with continuous-rapping devices.

The boilers normally operate as pressurized units, using only the forced-draft fans. Induced-draft fans have been provided to permit suction firing in emergencies.

Each twin furnace is equipped for tilting tangential corner firing. Coal burners are located at two levels and oil burners are on a third level. There are 32 coal and 24 oil burners per boiler.

The two gas-recirculation fans per boiler take part of the relatively cool flue gases leaving the economizer and

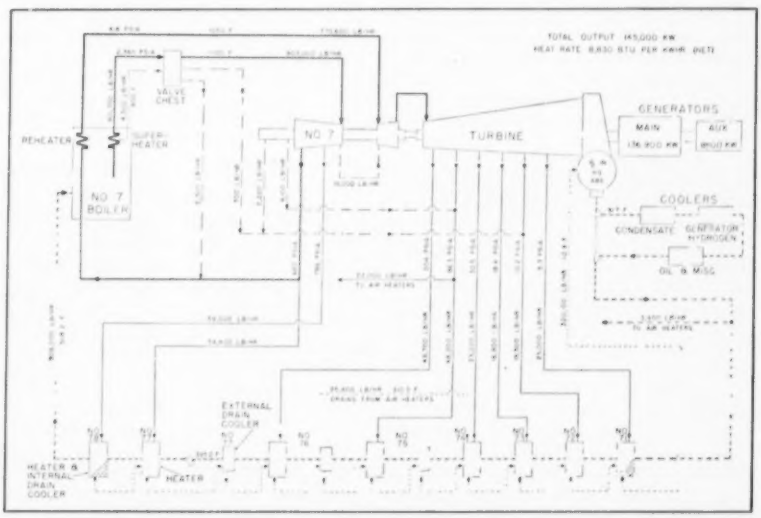


Fig. 4. Heat balance of one 145,000-kw unit; eight stages of fw heating; heat rate is 8830 Btu per kwh

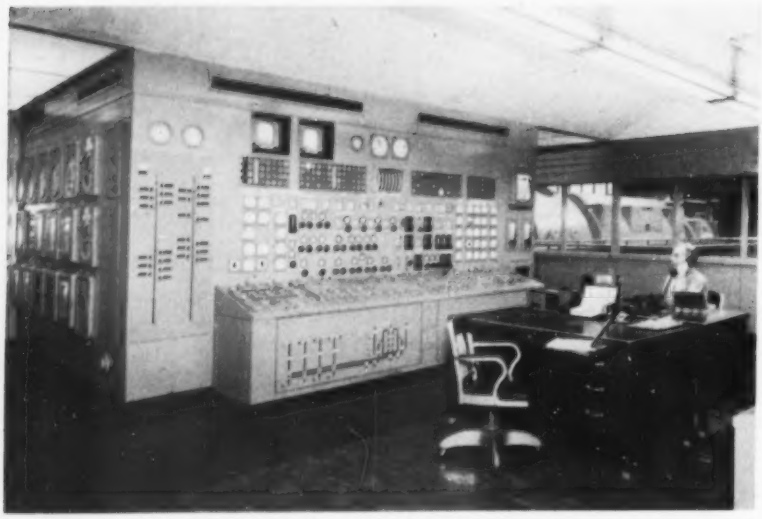


Fig. 5. Central control room for new units. Board has miniature instruments and tv; recorders are at left

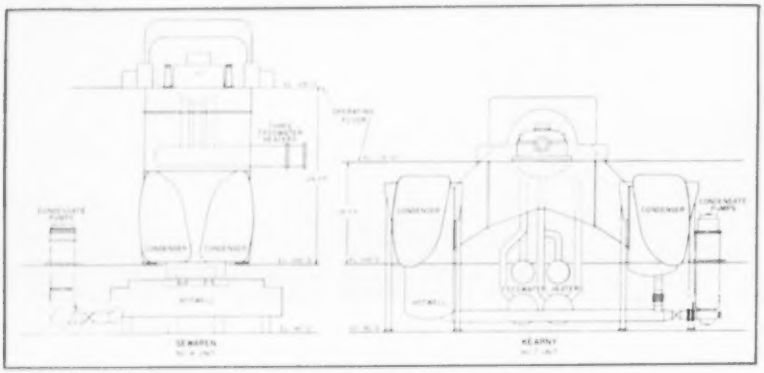


Fig. 6. One of Kearny features is its side-exhaust turbines, each with two side-mounted condensers. It was possible to place operating floor only 15 ft above ground floor and fw heaters below turbines

deliver it to furnace ports located between the middle and lower levels of burners. Control thus afforded makes it possible to maintain design steam temperature with a lower furnace temperature when burning coal, thus minimizing slagging, also make it possible to attain design steam temperature when burning oil. Spray desuperheating is also provided in both the superheater and reheater for additional steam-temperature control.

The furnace wall tubes are 1½ in. and 1⅝ in. outside diameter. Each tube is provided with an orifice designed to control the flow so that it does its proper share of work. Design heat-transfer rates can be higher for controlled circulation because of known water velocity and relatively thinner tube walls.

Gas-leak tightness of the pressurized furnace is attained by making the pressure barrier at the waterwall tubes, each of which is welded to a bar spacer placed between adjacent tubes. Most of the joining for this construction was done in the shop, and the waterwalls were shipped to the site in panels ranging in width from 15 to 24 tubes, and in length from 24 ft to 49 ft. Since the waterwalls are tight, the necessity of constructing the furnace casing to be leak-tight was avoided. It also effected a saving in erection cost of waterwalls due to fewer field welds.

For controlled circulation, each boiler has three vertical, single-stage circulating pumps, each rated for 40-psi differential head at a flow of 7300 gpm. Two pumps operate at full load. The boiler has been operated up to 145,000 kw with one circulating pump.

Generators Are Unique

The turbine generators are unique in respect to their high steam conditions: 2350 psig, 1100 F at throttle and 1050 F reheat temperature. They are tandem-compound, 3600-rpm machines consisting of a high-pressure section, a single-flow reheat section, and a triple-flow low-pressure section. Before entering the reheat section, the reheated steam returns to the inner portion of the high-pressure element and does work in three stages before crossing over to the intercept valves at the inlet of the reheat section. This arrangement saves the intercept valves from exposure to 1050 F steam. It also groups the high-temperature parts compactly to improve thermal-stress conditions in shaft and casing.

Each turbine drives the main and auxiliary generators in tandem. The auxiliary generator supplies power for the normal operation of the unit's auxiliaries.

Arrangement of Condensers

The Kearny condensers are arranged as twins to accommodate the side-exhaust turbine. The tube banks are inverted so that the exhaust stem enters horizontally and flows up to the air cooler at the top, while the condensate falls down to the hot well. Deaeration of make-up and drains takes place in the steam space ahead of the tube banks. Each twin condenser is supported at about the same elevation as the turbine foundation by four vertical columns connecting to support brackets at the top of the shell. A feature of the condensers is the use of rotating-plunger type pumps as vacuum pumps, similar to those at Sewaren.

Two boiler feed pumps in series with two condensate-booster pumps (re-entry type) are required to feed one boiler at full load. See Fig. 3. One spare boiler feed pump is installed for the two boilers, and is arranged to serve either unit. It does not start up automatically.

Central Control

One room, soundproofed and air conditioned, Fig. 5, is provided for all the controls of the two units. The panel components are miniature and compactly arranged. From his regular station the operator sees only the instruments that are necessary to operate the plant. Instruments for record purposes only are located in the wings of the control room. Telemetering is used extensively. Television apparatus is provided for viewing combustion conditions in one boiler.

High-Temperature Parts

Entire main steam system, from the superheater-outlet header to the first-stage nozzle of the turbine, is made of austenitic stainless steel, chromium-nickel-columbium stabilized. This includes the main steam piping, turbine stop valves, control valve chest, and a section of the inner high-pressure turbine shell. The main steam piping was made by forging and boring. The materials of the superheater tubes, starting from the primary end, are carbon steel, carbon-molybdenum steel, chromium-silicon-molybdenum steel, and chromium-nickel-titanium stabilized steel.

The hot reheat piping is made of 2¼ per cent chromium — one per cent molybdenum steel, rolled from plate and welded. Materials of the reheater tubes of the steam generator, starting from the low-temperature end, are carbon-molybdenum steel, chromium-silicon-molybdenum steel, and *continued on page 106*

Diesel Powers Plant at 15,800 Ft

It takes a lot of extra capacity for a given load at 15,800 ft. These four units at the Volcan Mines Co., Ticlio, Peru, have a sea level rating of 1260 kw (combined), but are generating 750 kw at their unusual altitude. They are helping men extract lead, zinc, copper, and silver from this mine 400 years old

Fig. 1. Perched on top of the Peruvian Andes, the concentration plant for the Volcan Mine has no troublesome neighbors

YOU LEAVE Lima, Peru, by automobile and drive steadily upward for four hours, with no downgrades. This brings you 86 miles to the Volcan Mines Co. of Ticlio, Peru, where an installation of four diesel-electric sets is operating continuously at an elevation of 15,800 ft. It is believed to be the highest installation of diesels in the world generating as much as 750 kw (sea level rating of 1260 kw).

When the diesels were first started up in January, 1953, tests revealed that all four were "hunting" badly and that the load was not balanced between the units. It was believed that the trouble was in the hydraulic oil in the governor, and subsequent experience indicated that this was the case.

Low air pressure at that altitude increased the relative vapor pressure of the governor oil and created a greater tendency to foam. Since any foaming of oil is detrimental to good governor operation, it was decided to change to a hydraulic anti-foam oil. After the oil was changed in all four governors and compensating adjustments were made, no hunting took place and all four units assumed equal shares of the load when paralleled.

All engines are now working satisfactorily and no repairs have been necessary to date. The engines are generally started without the aid of ether capsules, since the power house is warmed by the other engines, some of which are always in operation.

A great deal of interest has been shown in the tests by operators of other mines in the vicinity. Apparently they are considering similar installations to solve the tough high-altitude power problem.

Owners of the new plant, a Peruvian-American mining concern, are operating a newly constructed concentration plant in conjunction with the mine. It processes 400 to 450 tons of lead, zinc, copper, and silver ore a day. The mine, situated where the Central Railroad and the main highway cross the top of the Andes, has been worked for its gold and silver since the early 1500's.

In 1944, the mine was restored to produce lead and zinc for the U. S. government. The large deposits were quickly developed and Volcan got into the war effort in record time. Ore reserves were considered sufficient to justify construction of the new concentration plant and power plant, which were begun in 1951. At present, it is one of the most modern of Peru's industrial plants.

Editor's Note: If any of you readers have heard of or have experience with diesel plants operating at considerable altitude, such as the Volcan installation, we would appreciate hearing about it. Any operating experience with such high-altitude plants would be of interest to other readers.

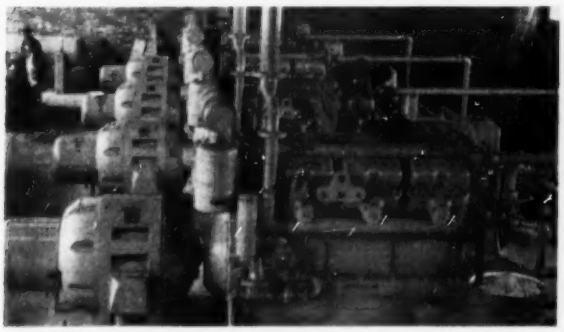


Fig. 2. Generator ends of the four diesel-electric sets. Each unit has sea level rating of 314 kw, develops 187.5 kw at 15,800 ft. Supercharging blowers are standard equipment for units but are especially valuable in thin air

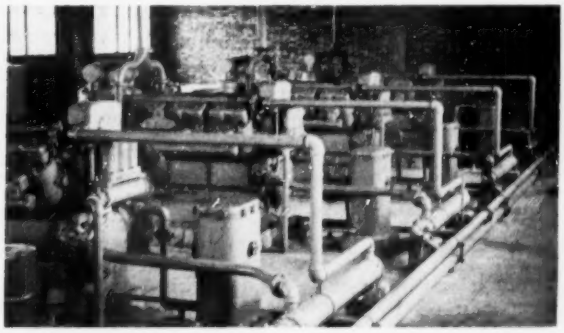
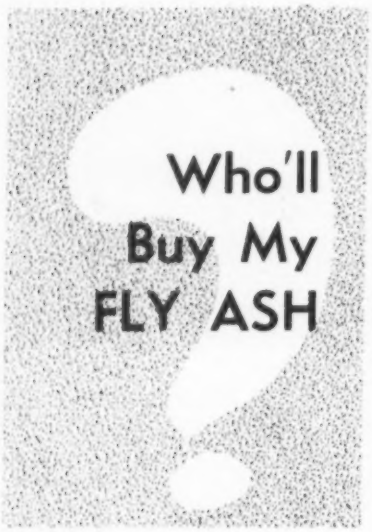
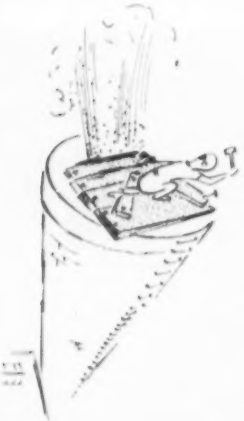


Fig. 3. Diesel ends of diesel-electric sets. Engines have 12 cylinders with 5¾-in. bore, 8-in. stroke, in a vee block. A closed liquid system operating under regulated pressure cools engines at that altitude without coolant losses



Markets for fly ash don't just happen; they are developed and then they are serviced. Here are a few pointers on how to develop a market for your own production and how to keep it sold. But don't think that all fly ash can be used for all applications. Properties of a particular ash determine its own applications



EVERY NOW AND THEN, someone in the power industry comes up with the sage (if somewhat rueful) observation that "the most effective treatment for the fly ash problem is to teach the public to like it." While this is usually good for a small laugh, the public in general does not join in.

Public aversion to abrasive air has resulted in some pretty stiff ordinances against dust emission, and these in turn have resulted in the development of several effective methods for the removal of fly ash from flue gases. Generally speaking, the more effective the method, the more it costs. Many utilities have spent more hard cash on this form of public relations than on any other. To make matters worse, the more effective the method, the worse becomes the disposal problem. In many areas, any large hole in the ground which the owner does not mind having filled is looked upon as heaven-sent relief to the disposal dilemma.

Mollendorf at Bat

It is not surprising, therefore, that the power industry was immensely pleased with and proud of its black sheep when commercial markets were found for fly ash. This fatherly pride is apparent in the recent exchange between J. D. Mollendorf (vice president of Chicago Fly Ash Co.) and television's Arthur Godfrey. When Arthur Godfrey spoke disparagingly of fly ash during the 1953 New York City "smaze" or "smog," Mollendorf was moved to reply:

"I didn't like your tone of voice when you referred to fly ash last night. I'm not mad, but do you know that fly ash saved millions of dollars for the taxpayer at Hungry Horse Dam, located near Hog Heaven, Montana? . . . I think it is exciting and thrilling to find such wonderful uses for a by-product you so scornfully referred to as 'soot'. You'd be excited and thrilled, too, if you could find a good use for your used tea bags."

The exciting and thrilling use to which Mollendorf referred was the addition of fly ash to concrete mixtures to (1) improve physical properties of the concrete, and (2) frequently reduce the cement requirements, thereby reducing the cost of the mix. This is the major market thus far developed for fly ash, but by no means the only one (see Table II). With the development of these uses for fly ash, many of its unwilling producers have stopped asking, "Who'll *take* my fly ash?" and have begun asking instead, "Who'll *buy* my fly ash?"

This is a good time to stop, however, and examine the problems inherent in the "fly ash business." It is not all roses, as some have found.

Naturally, anyone selling fly ash (like any other product) wants the top price available. So, what determines price? Just as with any other product, it will be competition and value. Both of these terms require a little examination in the light of problems pertaining specifically to fly ash.

One of the principal uses of fly ash is as a fine filler or aggregate in bitumastic or asphaltic products. As such, it is in competition with some extremely inexpensive materials. In some cases, *some* fly ash has shown quality as well as cost advantages in these applications. It should, therefore, be able to command an equal or greater price than the fillers which are replaced. Otherwise, the price will probably have to be set low to compete with more abundant (thereby more reliable in supply) materials purely on a cost basis.

Pozzolanic Admixture

As mentioned before, the major fly ash market thus far developed is for concrete admixtures (not to be confused with fine aggregates). This application reduces the Portland cement requirements by up to 20 per cent by adding fly ash in excess of the amount of cement replaced. Improved properties result from the "pozzolanic action" of fly ash. This is a reaction between the ash, water and lime set free in the hydration of cement, and this reaction forms insoluble calcium silicates. The lime would otherwise be free to leach out of the concrete, whereas with fly ash it is made into an additional cementing material.

Potential demand for fly ash as a concrete admixture is so great that, if fully exploited, it could well exceed the supply. The same is true of the bitumastic filler application, which could develop into a larger market than all other uses combined.

Several factors are still missing from this description of the fly ash (or any other) market. Quality control of the product and assurance of a continuous supply as needed are both extremely important to the customer and, therefore, to the sale.

ASTM Specification

It is not true that "fly ash is fly ash." It is understandably difficult to convince some of the heaviest producers of fly ash of this fact since they have had a single unpleasant name for the stuff for years. For a rough idea of the variable nature of fly ash, however, see Table I. Once a specific coal is selected, of course, there is little that can be done about the fly ash analysis except to hold down the carbon content in the ash. Excessive carbon (wasteful in itself) can eliminate a particular fly ash from the admixture or filler market.

Some day in the near future, the ASTM is supposed to set some standards governing the use of fly ash in its various capacities. It is hoped that this will take the guess-work out of specifying fly ash admixtures and fillers and give the producers some sort of control mark to shoot at. At present, many engineers and architects are shy about introducing

a relatively unknown factor into their calculations, especially in view of the varying analyses.

Let us assume that all technical opposition has been overcome by proved and guaranteed fly ash analysis, the effect of fly ash on the product has been proved advantageous, and the cost has been agreed upon to the mutual delight of all concerned. At this point we discover that we are not out of the woods yet. What about supply? What about delivery?

The alternate use of hydroelectric power or dump gas fuel during the warm months puts the fly ash producer exactly out of phase with most of his market. Unless he has some truly tremendous storage facilities, he may have to dump most of his production in a nearby marsh and then default on shipments during the summer.

If a concrete products firm with fairly steady demand teams up with a year-round producer of fly ash, the combination should be ideal. Even then, however, storage facilities in excess of the unit purchase tonnage should be provided at both the customer and producer plants. For example, a customer buying a truckload or a carload at a time would need storage for 1½ truckloads or carloads, as would the supplier.

Delivering the Goods

Fly ash is presently being delivered by several plants in covered rail cars and closed highway trailers. At least one company is bagging the dry material (at a cost of about $4.00 per ton) in 75- and 100-lb bags. Other companies have shipped the ash wet in open gondola cars with 5 to 10 per cent water to prevent loss of the material en route. Both good and bad results have been reported for this method.

One of the advantages apparent for bagging fly ash is that special storage facilities, aside from typical warehouse space, are not required. Costs for this operation, given above, are quite variable and depend on the personnel and equipment used.

Table I. Physical and chemical properties of fly ash in per cent by weight as collected. Samples are from 46 public utilities and 8 industrials as reported in 1949 by H. S. Walker, Detroit Edison Co.

Property	Utilities	Industrials
Carbon as C	0.37–36.2	2.4–64
Iron as Fe_2O_3 or Fe_3O_4	2.0–26.8	10.6–43.6
Magnesium as MgO	0.06–4.77	0.10–1.49
Calcium as CaO	0.12–14.73	1.92–11.8
Aluminum as Al_2O_3	9.81–58.4	10.0–21.0
Sulphur as SO_3	0.12–24.33	0.66–28.0
Titanium as TiO_2	0.50–2.8	0.22–3.81
Carbonate as CO_3	0.05–2.6	0.05
Silicon as SiO_2	17.3–63.6	25.0–46.0
Phosphorus as P_2O_5	0.07–47.2	0.05–1.93
Undetermined	0.08–18.9	—
Retained on 325 mesh	8–95	29–84
Through 325 mesh	5–92	16–71
Fusion temp. of ash (F)	1910–3000	1980–2900
pH value	4.7–11.7	6.3–12
Apparent specific gravity	0.79–3.0	0.77–1.45

Special facilities at the customer plant for handling the material in bulk are normally required. Recently, a small plant specializing in mixed-in-transit cement managed this change for about $2,000. In the average plant, however, new facilities will probably run between $10,000 and $20,000, depending on size, and can be paid off in 3 to 4 years through savings effected by the use of fly ash.

Engineering help for the potential customer should help convert many borderline cases into firm customers. Many of the concrete and bitumastic materials plants in this country are definitely interested in fly ash as admixtures and fillers, but are slow to take on more problems than they already have. Specific help in the handling and storage of what is to them a strange material will close many sales. Another article (appearing at a later date) will discuss the customers' handling facilities.

Summary

The power industry finds itself in an unfamiliar situation; they have something to sell besides power. They did not *want* to make this product, but it is hard to figure a way around it. Now they have a chance to sell that which for generations they have been dumping.

It is most unlikely that customers will ever come to the power company and take the fly ash away unbidden. Like any other product, it must be sold. Like any other product, the characteristics must be accepted by the customer; after that, the supplier must maintain the characteristics within specified limits. An account will prove most successful when it is "serviced" with engineering help. Also, deliveries must be maintained.

Local markets will probably prove most desirable if the production can be absorbed. Lack of long-distance liaison can prove a very valuable asset. Heavy producers will, of course, take advantage of a big market wherever it can be found.

When a choice of markets is possible, it is always better to choose the market in which you can compete on both quality and cost. In the fly ash market, pozzolanic properties of ash are quite valuable to concrete products on both counts. Bitumastic products (including, of course, highway surfaces) utilize the void-filling properties of fly ash and can stand a higher percentage of carbon than can concrete. A summary of other uses for fly ash is shown in Table II.

Since the power industry in general is undergoing a more-or-less continuous expansion, it would seem to be an excellent opportunity for the industry to show off its by-product by specifying the use of fly ash in its own roads and buildings. This would indicate the faith of the "manufacturers" in their own product as well as resulting in substantial savings in construction costs. In many cases, this has already been done. Sixteen years of exposure on the shore of Lake Michigan have proved the merits of a long retaining wall built on this basis. Much more of this sort of internal promotion could be and definitely should be practiced. To do otherwise would obviously imply:

"It's good enough for the customers, but not good enough for us!"

A bibliography of data on fly ash problems can be obtained by writing the Editors or writing "Fly Ash" on the request card elsewhere in this issue.

Table II. Commercial uses for fly ash, tried with varying degrees of success over the years, as recorded (in part) by H. S. Walker of Detroit Edison Co. Success of each market varies with the local conditions

Used In	Application	Replaces or Supplements	Success of Application	Commercial Possibilities
Filters	Filter medium	Fuller's earth, sand	Poor	Poor
Grinding	Abrasive	Pumice	Bad	Bad
Paint	Filler	$CaCO_3$	Poor (color)	Poor
Fertilizer	Filler	Sand	Good	Poor (cost & handling disadvantages)
Bitumastic roads	Filler	Limestone and silica dust	Very good	Good
Rubber goods	Inert Filler	—	Poor	Poor
Soil	Amender (agricultural)	—	Good	Poor
Cinder concrete	Fine aggregate	Sand	Good	Good
Foundries	Facing sand	Facing sand	Good	Fair (local markets)
Putty & caulking materials	Filler	Probably Fuller's earth	Poor	Poor
Building blocks	Extender	Brick clay	Good	Good (local markets)
Concrete	Pozzolanic admixture	Cement	Excellent	Excellent
Portland cement	Extender	Clay	Indefinite	Indefinite
Asphalt tile	Filler	—	Good (dark colors)	Fair
Insulating cement	Pozzolanic admixture	Asbestos shorts	Excellent	Fair (small markets)
Soil stabilizing	Binder	Mix with lime	Good	Excellent

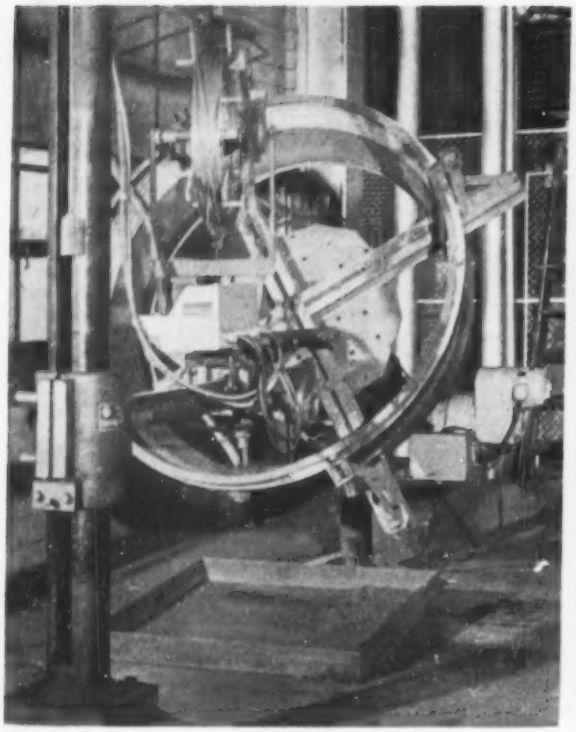


Fig. 1. Submerged arc method of applying hard-facing to pulverizer mill ring

Fig. 2. Worn pulverizer roll after resurfacing for third time with hard weld

Automatic Hard-Facing of Worn Pulverizer Parts Pays Off

By **RICHARD RUGGIE** *

SINCE 1940, The Cleveland Electric Illuminating Company has installed approximately 784,000 kw of capacity. To accommodate this capacity in the boiler plants, thirty bowl-type pulverizing mills have been installed. These mills vary in size from 14 tons per hour milling capacity to 18 tons per hour.

For proper combustion in pulverized fuel fired boilers, the coal must be ground to a fineness of 70 per cent through a 200-mesh screen. Maintaining this fineness and efficient performance, with a minimum of maintenance on the parts subjected to severe abrasion, led to the practice of hard-surfacing mill rings and rolls.

The initial hard-facing was applied by hand. Results of these first applications were fairly successful. Although the ring and roll service life were not substantially increased, the quality of coal leaving the mill was more uniform over the entire period of ring and roll service. Fewer adjustments of rolls were required between mill ring and roll changes. Mill rings and rolls were being removed for refacing rather than being worn to destruction. Mill capacity was maintained at a high standard by the elimination of worn parts. The electric power required to pulverize a ton of coal was reduced by approximately one kwh per ton.

The progress made seemed to warrant the continuance of the hard-facing. New problems, however, resulted in the process. These were:

1. Some of the 1090 carbon steel rings cracked during the welding process. This was later overcome by the application of the hard-face metal to a 1040 carbon steel ring. The new rings are one-half inch larger on the I.D. for application of the hard-facing.

2. The cost of hard-facing a ring or roll very nearly equalled the cost of new rings and rolls. In addition, the process was very slow.

3. The application of the hard-face was uneven and uniformity was difficult to control. The direction of hard-face beads was perpendicular to direction of rotation.

4. The hard-face metal frequently spalled and exposed the parent metal to the abrasive action of the coal. Quite frequently a ring or roll had to be removed prematurely because of this spalling.

The subsequent search for better methods resulted in the present submerged type arc method of automatic or machine hard-facing of the mill rings and rolls.

At present a Stoody 103 bare wire with a union melt flux is being used. Other types of wire and flux are also being tried.

The materials purchased to machine hard-face mill parts were:

1. One automatic welding head.
2. One head-holding device or boom which allows free adjustment of the welding head and permits the advance of the head manually for subsequent welding beads.
3. One flux recovery unit.
4. A 600-amp welding machine.
5. One standard positioner with hand tilt, variable-speed table top.

* Superintendent, Lake Shore Plant, The Cleveland Electric Illuminating Co., Cleveland Ohio.

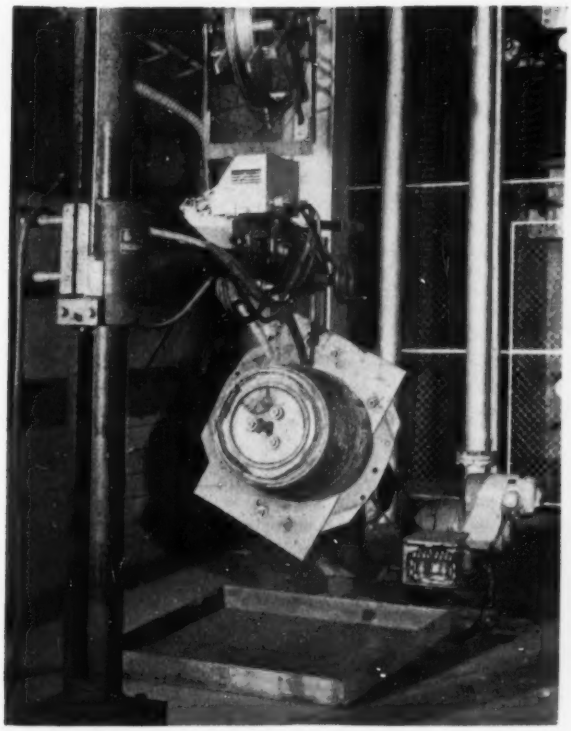


Fig. 3. Hard weld being automatically applied to surface of worn mill roll

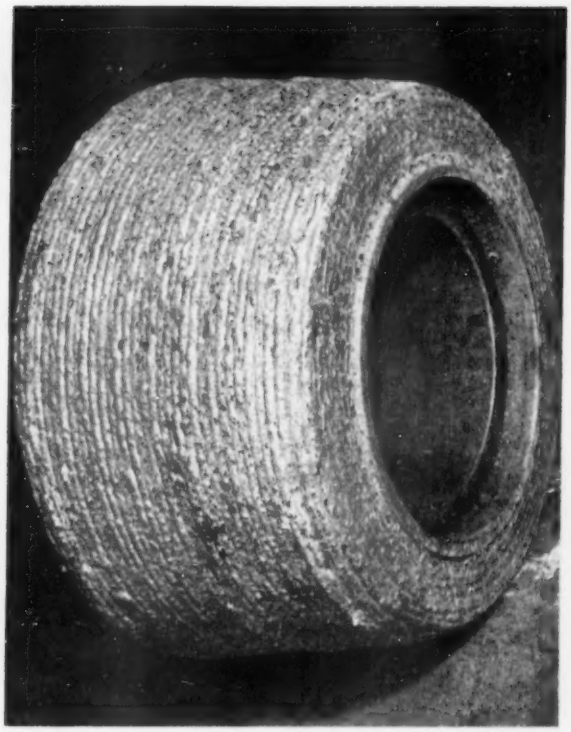


Fig. 4. Pulverizer roll after completion of automatic hard-facing operation

The procedure used for application of the hard-face is:

1. Prepare surface for welding.

a—The face of the ring or roll is power brushed to a bright polish.

2. Preheat part to be repaired.

a—Rings are preheated to about 250F. A slightly higher temperature is desirable for good bonding of the hard-face to the base metal; however, experience has proved that the ring picks up heat during welding.

b—Rolls are preheated to about 400F. Heat is applied slowly so that the roll is evenly heated to the core. This usually requires about two hours.

3. Application of the hard-face.

a—The application of the weld metal is done at a speed of 21 to 23 inches a minute with an ampere range of 340 to 370, and a voltage range of 22 to 27. The operator determines the best combination of speed, amperage, and voltage.

b—Initially, two passes of hard-facing are applied to a new ring or roll, each pass being about one-eighth inch thick. Subsequent layers of hard-face are built up to the original one-fourth inch thickness.

c—Normally, welding on iron castings is not recommended, but the application of hard-facing to the nickel-bearing chilled cast-iron roll has been very satisfactory. Welding of the roll is done with the welding nozzle placed off center toward the left, with the roll moved in a clockwise direction so that the flux is adjacent to the nozzle for a maximum length of time. The flux tends to ride the roll to the top before falling off the roll, thus giving the molten hard-face metal time to chill before the flux falls away.

Results of machine or automatic hard-facings are:

1. Present savings are approximately $900 per mill per year.

2. The finished face is smooth enough to put the ring into service without grinding or dressing.

3. Coal fineness of 70 per cent through a 200-mesh screen is maintained with fewer adjustments between ring or roll changes.

4. Tonnage of coal pulverized between maintenance outages is increased from 60,000 to 120,000 tons on a ring, and from 50,000 to 60,000 tons on a roll.

5. Spalling of the hard-face metal from the base metal has been eliminated.

6. Time between ring changes has increased from eight to 14 months.

7. Parts can be refaced many times. The oldest rings and rolls in service have milled over 250,000 tons of coal. The oldest ring in service has been hard-faced three times. The oldest roll has been hard-faced four times. There are no foreseeable limits to the number of times these parts may be re-faced.

Fig. 5. Worn mill roll before first resurfacing

Fig. 6. Worn roll before its second resurfacing

These National Safety Council photographs, taken in and around a small high voltage outdoor installation, show

Ways To Get Hurt In a Substation

Fig. 1. Gloves should not be used here. They can be trapped by the roller without a man realizing his fingers have been caught till it is too late

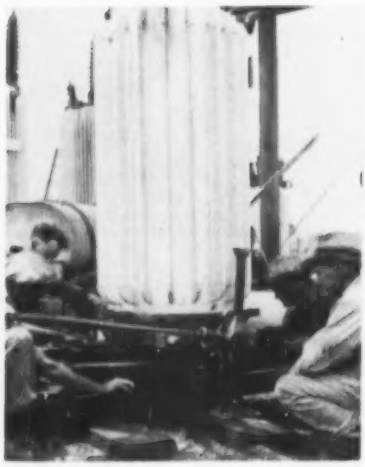


Fig. 2. A poor cribbing job. Bottom timbers are not centered under the tank; the jack is badly placed, and the handle has been left in the jack

Fig. 3. Sliding down a switch handle is obviously dangerous, but a surprising number of substation accidents are caused by similar foolish behaviour.

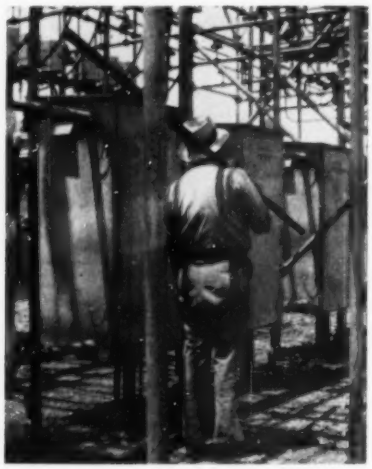
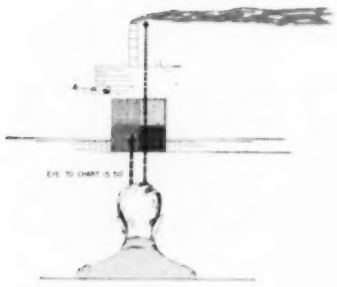


Fig. 4. Wrong way to carry a bar or piping in an energized area. When not in use, the bar should be carried so no part of it is above waist level

Fig. 5. When changing high voltage fuses or doing any other work on the live parts of a transformer bank, one side of the bank must always be grounded

Fig. 6. Balancing on a single timber substation structure is hazardous at any time; with climbing spurs on, it can be an efficient way to commit suicide



What Are Anti-Smoke Laws Worth?

By ALBERT WOODRUFF GRAY

A STEEL manufacturer in California, recently convicted of a violation of an anti-smoke statute of that state, contended in its defense that the statute was void for uncertainty and discrimination.

The statute provides, "A person shall not discharge into the atmosphere from any single source of emission whatever, any air contaminant for a period or periods aggregating more than three minutes in any one hour which is (a) as dark or darker in shade as that designated as No. 2 on the Ringelmann chart, as published by the United States Bureau of Mines, or, (b) of such opacity as to obscure an observer's view to a degree equal to or greater than does the smoke described in subsection (a) of this section."

Value of Ringelmann Chart

In its decision a few months ago, upholding this conviction, the California appellate court made the following statements:

"It is a plain white piece of paper divided into four squares, numbered from 1 to 4 and each about 5¾ x 8¾ in. in size. On each of these sections is printed a series of intersecting heavy black lines of uniform width for each section with lines growing progressively wider from section 1 to section 4, until on section 4 the black covers more than half of the surface.

"The chart is to be posted at a distance of 50 feet from the observer. When so posted the black lines and the white spaces merge into each other, by process of optical illusion, to present the appearance of a series of grey rectangles of different color density, No. 4 being the densest.

"Estimate of the density of smoke may be made by glancing from this chart so displayed to smoke and picking out the section of the chart which most nearly resembles the smoke. This mode of measuring the density of smoke has been in use, it appears, for over 50 years.

"This affords a reasonably certain mode of determining and stating the density and opacity of smoke and we think that the statute adopting it is not lacking in certainty."

Of the contention by this offender that the statute was discriminatory since one who permits the discharge of smoke only slightly below the prohibited color or opacity is excused even though the aggregate volume discharged in the air by another is greater than the more dense discharged for a shorter period, the court said:

"The line must be drawn somewhere or there can be no classification and the courts have recognized that if the classification is reasonable in its over-all operation, it is not to be stricken down because of its application to a particular case that may lie just inside its operations."

A year before this decision was rendered, the New York Central Railroad was convicted in a New Jersey court of violating a similar ordinance in the operation of its power plant at Weehawken, in that state. The charge was that the emission of smoke was of a greater density than that described as No. 2 on the Ringelmann chart.

The railroad in its defense maintained that the ordinance was void under the authority of a decision in that state that the non-negligent emission of smoke from the smokestack of a locomotive in the operation of a railroad was not within local control and, according to the court in this recent case, applied this principle in its defense, by analogy to a railroad power plant as a necessary operating facility.

Overruling this contention and sustaining the conviction, the New Jersey court said: "The principle has no bearing upon the function of terminal facilities and fixed installations such as engine houses and repair shops."

Due Process

Another defense interposed in a recent prosecution for the violation of a similar ordinance in Tennessee was that the ordinance was unconstitutional as it violated both the state and Federal Constitutions in taking away property without due process of law.

That ordinance was, "The emission of dense smoke within the City of Kingsport, except for a period of nine minutes of density No. 2 smoke, defined in the Ringelmann chart, or six minutes or less of a density in excess, is prohibited."

The Supreme Court of that state said in sustaining the conviction of an industrial plant, "There is no merit in the contention that the property of the corporation is being taken or destroyed by the ordinance without the due process of law and hence in violation of the state and Federal Constitutions. We cannot assume that the ordinance will be arbitrarily and capriciously enforced."

Unavoidable Conditions

The Cunard White Star Ltd. a few years ago appealed a conviction for the violation of an anti-smoke ordinance of New York City in the operation of the steamship Queen Mary. The company contended that all due and reasonable precautions had been taken to reduce the emission of smoke and that such smoke as may have been released was absolutely unavoidable.

In its reversal of this conviction the New York Court of Appeals said:

"In the exercise of the police power, the state may require industry and commerce to be carried on in a manner which will promote public health and welfare, though such requirement may increase the cost of doing business. Conflicting considerations of business advantage and the public health and welfare must be weighted by the legislature and the courts may not interfere unless interference with lawful business is manifestly unreasonable.

"Nonetheless, there is a point beyond which the legislature may not go and the courts must refuse to enforce a statute, ordinance or regulation in those rare cases where a legislative body has transcended the constitutional restrictions upon its power."

Adopting this statement of the law as controlling, the New York court, in acquitting the offender of violation of the ordinance, said:

"This legislation is regulatory in character and must be interpreted in the light of its necessity and the purpose to be accomplished. But this rule is subject to reason and the court must not close its eyes to obvious facts. The law does not seek to compel a man to do that which he cannot possibly perform.

"A reasonable interpretation should be made and if a person has complied with the literal requirements of the law as nearly as it is practicable to do under the prevailing circumstances and has adopted the best devices presently known to all, the letter and spirit of the legislation has been complied with."

COAL STORAGE COSTS

By W. H. EVERETT
Consulting Engineer

Increased construction costs have stimulated search for cheaper coal-storage facilities. Here costs are compared for bunkers, various types of silos, including low-cost, easily built plywood type, and outdoor storage

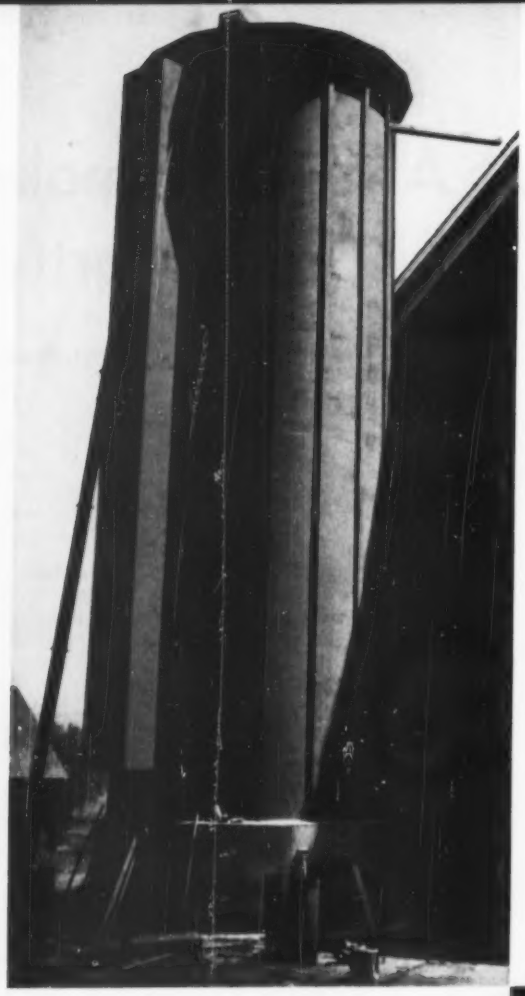


Fig. 1. Plywood silos like one shown at left are cheaper to build than normal types and their possible use for coal storage is discussed here

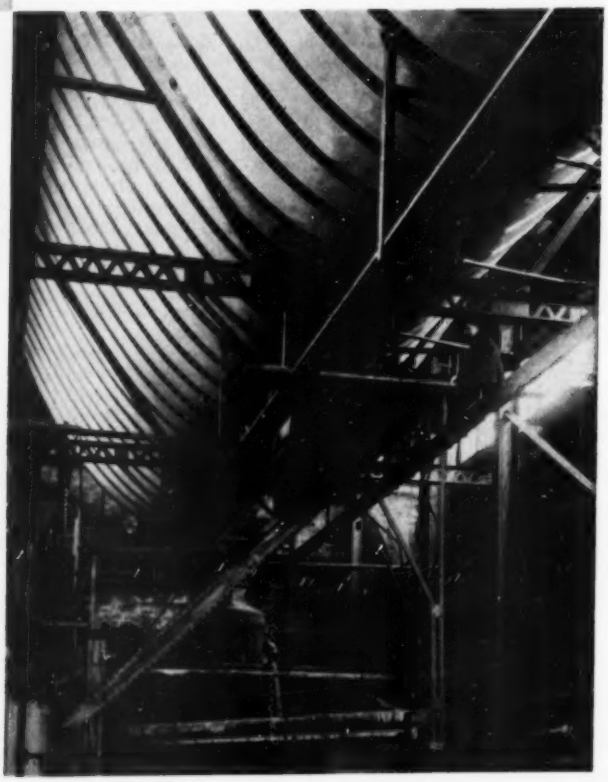
Fig. 2. (below) Good type of bunker construction. Steel straps along the whole length of structure provide an evenly distributed support

Fig. 3. (bottom left) Outdoor storage is much used by modern stations. Costs of inside and outside storage are compared in this article

SILOS

GROUND STORAGE

BUNKERS



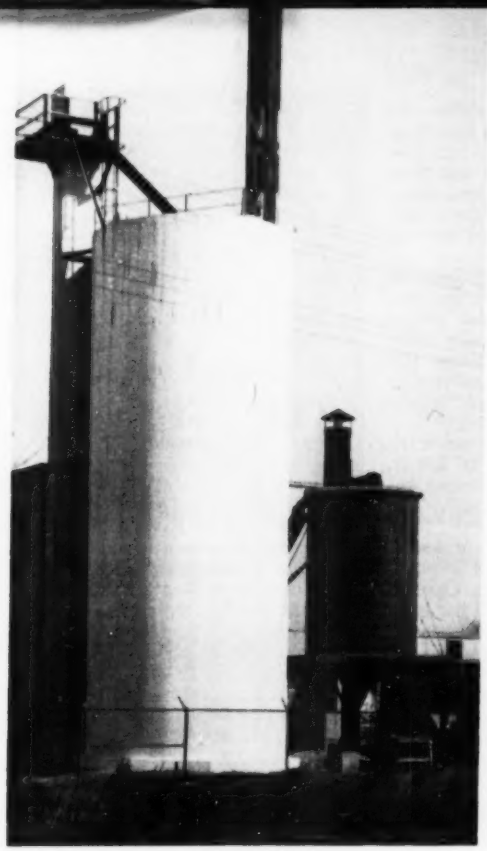


Fig. 4. Monolithic concrete construction is illustrated by silo in foreground. In the background is a small silo built of cinder blocks

Fig. 5. Shows a plywood silo in course of construction. The hoops are withdrawn when the silo has been completed and thrust is then taken by the vertical studs

TO VETERAN contracting engineers who specialize in power plant coal-handling work, current costs are unpleasant to contemplate. On the average job we once quoted $17 to $20 per ton of capacity on concrete silos for coal. Today's prices from a recent estimate for a silo 20 ft diam by 45 ft high, including foundation and roof: —

	Per ton
Concrete stave type	$43.50
Monolithic concrete type	56.00
Hollow tile	61.00

That means a 300-ton silo once priced at $6000 would now be quoted at $18,000. These three types of silos are shown in Figs. 1 & 2.

An interesting development comes from the west coast — the plywood silo. Detailed information can be secured from the pamphlet "Technical Data on Plywood" by the Douglas Fir Plywood Association, Tacoma 2, Wash. It is stated that a 25 ft diam by 35 ft high silo can be erected by three men in 8 days, once the hoops have been prepared, at a cost for material and labor of approximately $3600 — about one fifth of the cost of a concrete stave type silo. Figure 3 shows this type of silo in course of erection.

Although the plywood silo was developed for silage and grains, not for coal storage, it is interesting to consider the possibilities. To date the writer has been unable to locate such an application but it may be feasible. It has proved satisfactory for wheat which develops a much higher lateral or radial thrust than coal. A finished silo of this type is shown in Fig. 4.

Among the questions are: With frequent filling and emptying would there be objectionable abrasion of the wall? Is there a risk with coal subject to spontaneous heating? Is the plywood subject to attack from sulphur or sulphuric acid leached from some coals? To eliminate or reduce these factors of possible trouble, the silo should have an inside lining of fluted sheets of 18 ga stainless steel or copper-alloy steel, or even corrugated aluminum. With channels placed vertically, the lining could provide ventilating ducts in the event of heating and, if the coal does not ignite, damage to the plywood will not occur. Plywood can be treated with chemical salts at a cost of about 5 cents per sq ft to render the silo resistant to extraneous fires.

A plywood silo, chemically treated and with steel sheet lining will cost about 75 per cent less than the usual type of concrete silo. It has interesting possibilities. Sometimes a silo must have an elevated sloping floor or a hopper providing 50 tons or so of active storage. The plywood structure would require radical changes to take such a large vertical thrust.

Not to be outdone by the silo, bunker costs have climbed far above former figures. We will restrict our discussion to the lower-priced suspension type suitable for small and moderate capacities — say up to 1000 tons.

An unprotected steel plate suspension bunker will have a life of 10 or 12 years before the coal, often damp, destroys the "bag" by corrosion. The life can be extended by occasional cleaning and painting. These bunkers today cost around $36 per ton of capacity. This figure is not a comparison with silo costs as it does not include columns and cross struts, often part of the building structure. If these are included the cost will range from $50 to $60 per ton.

The concrete-lined suspension type bunker has a bag of ¼ or ⅜ in. plate with a lining of waterproof concrete on wire mesh. It costs around $46 per ton of capacity and has a life better than 20 years unless the lining develops cracks which are not attended to as soon as they appear.

Figure 5 shows this type of construction with steel straps spaced about 3 ft centers on which fluted steel sheets are placed. With the bag held to the contour it takes when fully loaded, a gunite lining varying from 4 or 5 in. at the bottom to 2 or 3 in. at the top sides, is applied. The

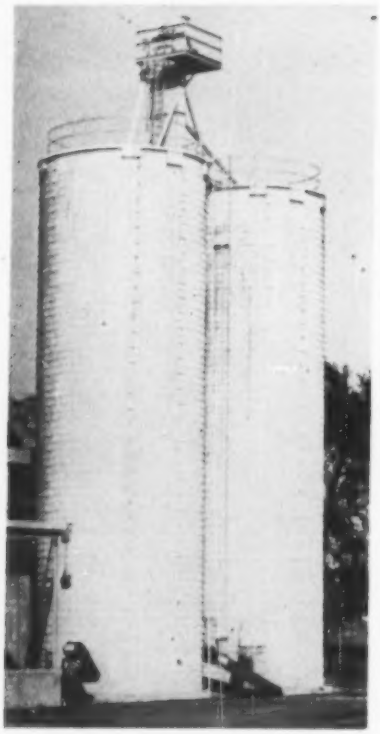


Fig. 6. Another common type of silo construction

cost is around $38 per ton of capacity — but little more than for the unprotected plate bunker. A number of bunkers of this type erected between 1910 and 1915 were inspected recently and found to be in practically the same condition as when put into service. Table 1 shows the weights and costs used to arrive at the above three costs per ton of capacity.

Ground Storage

In recent years outdoor storage has become very widely used. There were two main reasons for its increasing use. One was the growth of power plant capacity, requiring very large quantities of stored coal. The other was the enormous advance in the design and use of earth-moving equipment such as bulldozers, tractors, scrapers, carryalls, etc. that took place during and after the war.

If this equipment had not been developed for general construction purposes, it is hardly likely that the needs of coal handling alone would have produced anything like the advances that have actually taken place. However, the equipment has proved its value for coal handling and the power engineer has been able to benefit from the money and development put into this type of equipment for general construction purposes.

If a 3000-ton storage bunker or silo group is to cost $100,000 one turns toward the combination of a service bunker of moderate capacity, with a tributary ground storage in which the coal is stocked out and compacted, and from which it is re-handled by bulldozer or carryall as shown in Fig. 6. This means an extra handling of the ground stored coal but the reserve storage so provided can usually be far larger than 3000 tons without additional equipment cost, and enables the user to take advantage of seasonal price reductions and is a protection against interruptions in deliveries. Live-bunker storage capacity sufficient to carry the boilers over the week-end is usually considered sufficient. This allows the coal handling crew to work a five-day week and gives ample time for the maintenance men.

The bulldozer as a pusher can work economically on pushes up to 300 ft. Equipped with a 160 hp Diesel engine, it costs about $23,000. The handling capacity will range from approximately 160 tph on a 150-ft push to 120 tph on a 300-ft push, figuring on 4 tons per push. Operating cost approximates $6.00 per hour (not including depreciation, taxes, and interest on the investment). This means an average cost of about 4.1 cents per ton for stocking out, or about 7.9 cents per ton for stocking out and reclaiming. (Stocking out is on an adverse grade and reclaiming on a favorable grade.)

For larger operations we may combine the bulldozer and the carryall. This forms a unit costing about $30,000 with a heaped-load capacity of 16 tons. With a one-way haul of 500 ft the equipment will stock out or reclaim 230 tph. For 1000 ft the figure is 184 tph.

Stretching our argument somewhat, the mechanical equipment for a reserve storage of 30,000 tons over an area of 250 x 250 ft entails the same investment as required for a 600-ton bunker.

Coal Weathering

Spontaneous heating of bituminous coal in ground storage has been eliminated by spreading in layers and compacting by the heavy tires or track treads of the bulldozer. Extended research by the Bureau of Mines with New River, Pocahontas, Pittsburgh Gas and Sheridan Wyoming coals, showed that outdoor weathering caused no loss greater than 1.2 per cent the first year or 2.1 per cent in 2 years. In Appalachian coals oxidation starts at about 85 F and increases in rapidity with temperature increase. The presence of pyrites is a contributing factor, as is the exposed coal-surface area. There is no tendency to heat with anthracite coal; in fact the writer has seen coal stocked out during a snow storm, still frozen at the core when moved next summer.

Table 1. Typical 1953 construction costs for a suspension bunker of the type illustrated in Fig. 2

We assume a bunker of 900 tons capacity. Inside width 22 ft 2 in. Depth, 14 ft 10 in. Girder spans 31 ft.

Sq ft area of bag = 219 sq ft. Surcharge = 81 sq ft
For the capacity of 900 tons, bunker length = 120 ft

A. Unlined steel plate bunker.

Weight of steel—girders and end bracing		62,000 lb
⅜ in. bag and ends		68,000
	Total steel	130,000 lb
Fabricated steel taken at 15 cents per lb		
Drafting at 4 cents. Erection at 5 cents.		
Cost. 130,000 lb steel at 24 cents lb erected		$31,200
Painting		1,400
	Total	$32,600
Cost per ton of capacity	$36.22	

B. Steel plate bunker, concrete-lined—5 in. at bottom tapering to 2 in. at top sides on wire mesh.

Cost. Steel as before		$31,200
Painting, outside only		900
Lining, 5300 sq ft		9,600
	Total	$41,700
Cost per ton of capacity	$46.22	

C. Steel strap bunker with fluted sheets, gunite lining.

Weight of steel—Weight of steel girders and ends		68,000 lb
Straps, spaced 3 ft 3 in.		16,000
	Total steel	84,000 lb
Cost. Girders and ends 68,000 lb at 24 cents		$16,320
Straps 16,000 lb at 16 cents (minimum drafting and fabricating)		2,560
Fluted sheets		2,400
Forming bag and bracing to form		3,700
Inside lining, 5,300 sq ft		8,300
Outside painting (Scaffolding in place)		800
	Total	$34,080
Cost per ton of capacity	$37.87	

Fig. 1. Cross-section view of new integrally extruded steam traced aluminum pipe described here

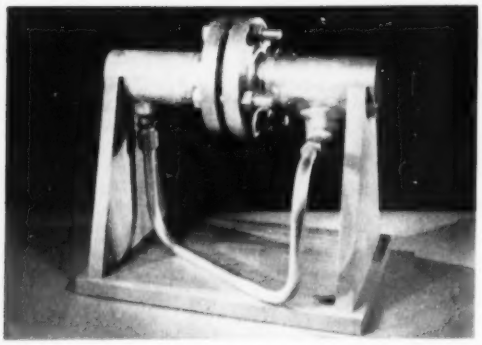


Fig. 2. View illustrating one of several methods of joining separate sections of this new type piping

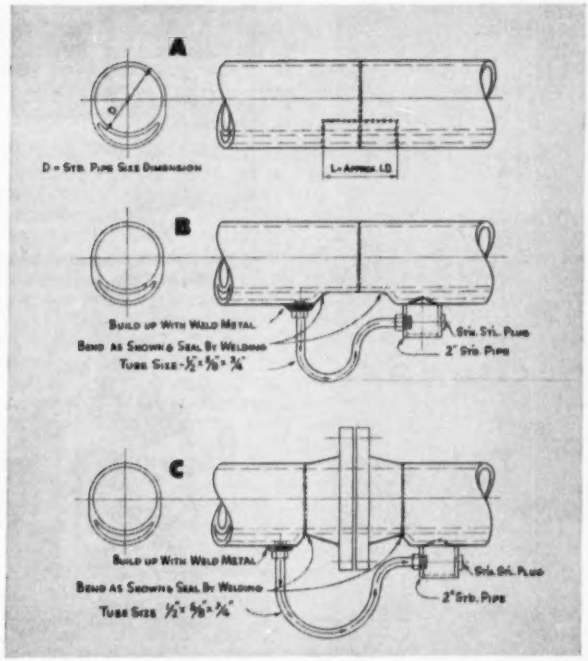


Fig. 3. Methods of joining new piping. A. Welding without use of jumpers or fittings. B. Shows the use of jumpers without fittings. C. The use of both jumpers and fittings

New Steam Tracing Idea

USERS of steam traced piping now have a totally new solution to their equipment problems in a new integrally extruded steam traced aluminum pipe which eliminates the separate tracing pipe which has been necessary up to now. Figs. 1 and 2 shows this new piping, and Fig. 3 illustrates the different ways of taking the tracing round coupling joints in the pipe.

Piping users who handle sluggish chemicals such as tar and pitch or solutions such as ammonium nitrate need heated lines to prevent their products from solidifying or crystallizing in the line. In contrast to the normal methods of heating lines by using an external steam jacket or steam tube to apply the necessary heat, in this new pipe the steam line is an integral part of the pipe.

Extruded as a single unit from aluminum alloy, the new product is slightly oval in cross section because of the crescent-shaped steam passage adjacent to the product line. The size now available has the pipe dimensions of 2 in. Schedule 40 pipe.

On the first job in which it was installed this new piping proved very successful. In this installation it resulted in the following savings over conventional 2 in. steam jacketed lines: 38 cents a foot saved on material, 5 cents a ft saved on insulation, and 30 per cent reduction in labor costs.

This new piping possesses greatly improved heat transfer properties over normal steam tracing techniques. The expense of steam jacketing and its installation is eliminated.

Pre-formed insulation will fit the new pipe. In the case of the 2 in. pipe, the new product is designed to that insulation for 2½ in. standard pipe will form naturally. When insulation is used, a smaller size can be used than with the older steam-jacketed piping. But because of improved thermal insulation will be unnecessary in many cases, particularly where set quantities of process steam are allocated for tracing purposes.

The new piping lends itself readily to shop fabrication of standard lengths. It can be formed easily using conduit tools.

Products for which this new piping should be particularly suitable include naval stores, molton sulphur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar and pitch, and similar products normally requiring steam tracing or steam jacketing.

The use of this new integrally steam traced piping will provide a more efficient use of steam and greater heat transfer. In addition to the natural corrosion-resistance of aluminum, the advantages of the piping include lower labor costs and lower insulation costs, as well as the possibility of omitting thermal insulation entirely.

The new pipe is available at present in standard 2 in. pipe size without die charge.

For more information about this new piping write to the Editor, or use one of the prepaid post cards you will find elsewhere in this issue. Just write STEAM TRACING on the card and mail it to us

How To Install Duplex Tubing

Duplex tubing consists of two tubes bonded together, one inside the other. The inner tube resists one type of corrosion, the outer tube, made of different metal, resists another type. Here are points to be observed during installation

By C. LAWRENCE BULOW

Corrosion Metallurgist, Bridgeport Brass Company

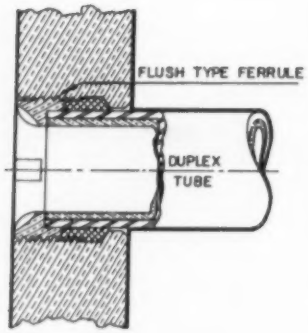


Fig. 1. Use of flush ferrule for tubing with a hard outer tube and soft inner tube

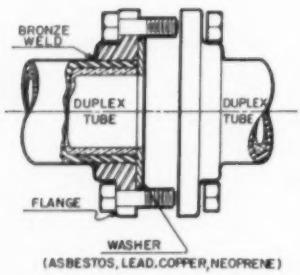


Fig. 2. Flanged coupling joint to minimize galvanic action in corrosive medium

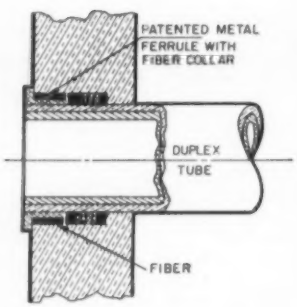


Fig. 3. For low pressure installations ferrule and fiber collar give a watertight job

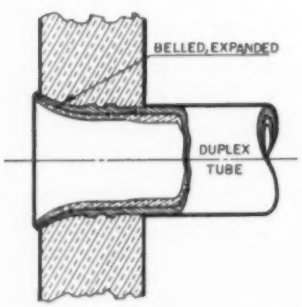


Fig. 4. For higher pressures end is belled and then expanded into the tube sheet

FOR TUBING subject to one type of corrosion on the inside and another kind on the outside, duplex tubing has been used very successfully. It consists of two separate tubes, made of dissimilar metals, one inside the other and mechanically bonded together. The metal for the outer tube is selected to resist the corrosive medium outside the tube, and the metal for the inner tube is chosen to resist the corrosion inside the tube. For example, in ammonia refrigeration systems, where water rusts away steel pipe, and copper does not stand up to moist ammonia, duplex tubing composed of steel for the ammonia side and copper for the water side solves the problem.

Many other combinations of metals are possible to resist different corroding agents and this type of tubing has widespread industrial use. Though it is handled in much the same manner as ordinary heat exchanger and condenser tubing, it naturally requires a slightly different technique for expanding or rolling into the tube sheet. Here are the most important points to be observed when installing or replacing this type of tubing, as explained in The Bridgeport Condenser & Heat Exchanger Tube Handbook and Duplex Tubing Technical Bulletin No. 1954.

Expanding and Rolling-In

Because duplex is generally stiffer than single-wall tubing, more care and effort may be necessary for the rolling-in operation. Tubing with a harder metal on the outside and a softer one inside may sometimes require special protection from the expanding tool during installation to prevent flaking of the liner due to excessive cold working. For this purpose, a snug-fitting copper sleeve about 2 in. long and ranging in thickness from 0.010 in. to 0.020 in. can be supplied. These sleeves may be left in place as they offer very little obstruction, or if desired, they can be removed when operation is completed.

Some combinations of duplex tubing made up of a hard metal on the outside and a very soft metal on the inside, are extremely difficult to

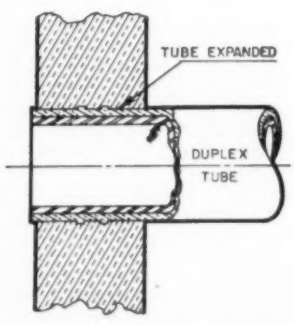


Fig. 5. This method is often used for high pressures and low liquid velocities

roll-in a tube sheet. For such combinations it is necessary to resort to ferrule type packing (see Fig. 1) soldering, brazing or welding.

When the soft metal is on the outside and the hard metal inside, the soft metal functions as a gasket in the tube sheet and rolling-in the tube sheet produces tight joints.

"Flaking" may take place in single walled tubing as well as in duplex tubing. It appears to be due to the expander roller sliding, rather than rolling, over the tube surface.

The proper size expander should be used for rolling-in duplex tubes. If the cage of the expander is too small, the tubes may be underexpanded. The rollers may be forced through the openings in the cage and thus damage the cage and lead to "flaking" of the liners of the duplex tube. If the tubes have been rolled several times, it may be necessary to use an expander for a lighter gage tube.

In certain sizes and combinations, some users prefer end-annealed duplex tubes. Before rolling-in, end-annealed duplex tubes should be preheated (400–500F) at the ends to expel any moisture from between the interfaces. Liquid cleaner should not be used after heating as it may be trapped in the crevice at the tube ends. Later, if used at a temperature high enough to vaporize the liquid, a pressure will be set up which may be sufficient to collapse the lining.

Due to the large number of combinations of metals and sizes, great variations in rolling-in characteristics exist in duplex tubing. Combinations of metals with similar hardness characteristics generally require slightly more power for rolling-in than the original metals themselves.

Electric or air-driven tapered tube rollers are recommended. Motors driven by air pressures of 65–125 psig have been reported by users as giving satisfactory tightness in the tube sheets. Some prefer to "set" the duplex tube in the tube sheet with a sharp blow on a drift pin.

Duplex tubing — copper outside, steel inside — when used in the construction of boilers and steam generators usually requires cutting back of the copper so that the tube can be seal-welded to the tube sheet. Sometimes the welding is preceded and/or followed by a rolling operation. Such tubes are often cut long enough to extend about ⅛ in. outside the tube sheet so that both the front and back of the tube sheet will dig into the outside of the tube and increase the strength of the joint.

Bending and Joining

Duplex tubing can be bent with the same tools and equipment as used for single wall tubing. In order to make sharp bends, local annealing may be necessary. In general, duplex tubes, copper-steel either inside or outside, can be bent to a radius of three times the O.D. of the tube.

When it is desired to join lengths of duplex tubing to each other in order to make long lines or coils, or for connecting return bends, fittings, valves, etc., couplings either of the compression type, solder or welded type can often be used. Connections are same as for ordinary tubing.

To mimimize galvanic action in corrosive media, special precautions should be taken. Here the familiar flanged construction as illustrated in Fig. 2 is suggested as a coupling.

For low pressure installations, the flush type brass ferrule with a generous bell mouth is suggested at the inlet end because it does not impede water flow and cause excessive turbulence. Duplex tubing is packed in the same manner as single-walled tubes. Also provision for expansion and contraction of each tube must be provided either by the use of an expansion joint or by allowing the outlet end of the tube to slide in its metallic packing used without a ferrule. Or if ferrules are used, movement of the tube should be provided for in the conventional manner.

Patented Metal Ferrule

For low pressure installations, a special metal ferrule with a fiber collar can serve instead of the brass ferrule shown in Fig. 1. This method of packing depends upon the swelling of the fiber collar to obtain a watertight fit between tube and tube sheet. This method, shown in Fig. 3, is limited to those applications where the circulating liquids will not attack the fiber and when there is no danger from serious galvanic action.

For higher pressure installations the inlet end is expanded and rolled into a serrated hole in the tube sheet. Since the inlet end of the tube is held firmly, provision must be made to take care of expansion and contraction of the tube at its outlet end. This is done by using a floating tube sheet or expansion joint in the shell of the condenser or heat exchanger.

When this method is used for installing tubes at the inlet end on low pressure units, metallic packing may be used at the outlet end to allow movement of the tube, as in Fig. 4.

The plain expansion illustrated in Fig. 5 is used on both the inlet and outlet ends where high pressure and low liquid velocities through the tube are involved. Where high liquid velocities are used, the belled inlet end is more desirable.

This method is used successfully where fresh water flows through the tube and ammonia gas and liquor are cooled outside as exemplified by coolers used in the coke industry and ammonia refrigeration systems.

For high pressures where it is necessary to prevent galvanic action at the tube sheet, a ferrule of the same composition as the inside of the duplex tube, and similar to the tube sheet, is used. This involves cutting off a section of the outside member of the tube indicated in Fig. 6.

For higher pressures such as those which exist on the compression side of an ammonia refrigerating system, the method illustrated in Figs. 7 and 8 is sometimes used. Here a portion of the outside member of the tube is cut off before inserting the tube into a heavy-walled tube sheet machined as illustrated, before tube is rolled in. It should be noted that a sleeve of the same composition as the inside member of the duplex tube is used on the outlet end as shown in Fig. 8. This design eliminates the possibility of galvanic action. By drilling a smaller hole in the fixed tube sheet, a sleeve at this point becomes unnecessary.

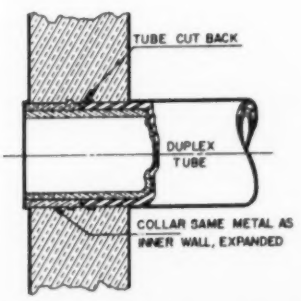


Fig. 6. A ferrule of same metal as the inner tube prevents corrosion in hp work

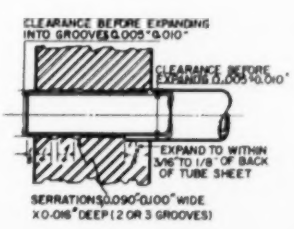

CLEARANCE BEFORE EXPANDING INTO GROOVES 0.005"-0.010"
CLEARANCE BEFORE EXPANDING 0.005"-0.010"
EXPAND TO WITHIN 3/16" TO 1/8" OF BACK OF TUBE SHEET
SERRATIONS 0.090"-0.100" WIDE X 0.016" DEEP (2 OR 3 GROOVES)

Fig. 7. A method often used on the compression side of ammonia refrigerators

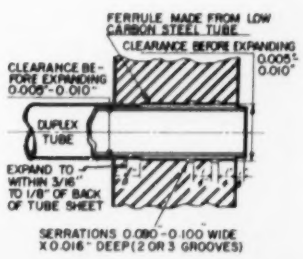
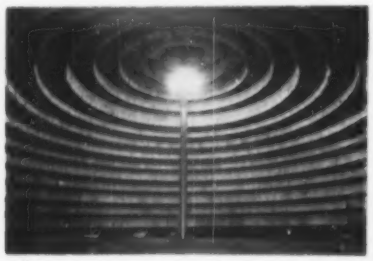

FERRULE MADE FROM LOW CARBON STEEL TUBE
CLEARANCE BEFORE EXPANDING 0.005"-0.010"
CLEARANCE BEFORE EXPANDING 0.005"-0.010"
DUPLEX TUBE
EXPAND TO WITHIN 3/16" TO 1/8" OF BACK OF TUBE SHEET
SERRATIONS 0.090-0.100" WIDE X 0.016" DEEP (2 OR 3 GROOVES)

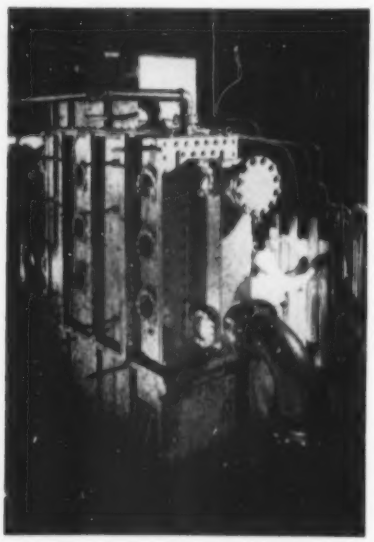
Fig. 8. Another method used on the compression side of ammonia refrigerators

Power Engineering's NEWS REEL

This month we look at some of the new facilities on the industrial scene. An entirely new method of construction, new research laboratories and even a demonstration room on wheels are being pushed ahead to aid engineers seeking answers to production and design problems



LeTourneau has introduced a bolted aluminum and steel "Semisphere" building. It costs less than $4 per sq ft and has 70,686 sq ft unobstructed floor area. Rings of plates are assembled on mast at ground level and each is raised the height of one ring as it is completed. The mast can be removed



Allis-Chalmers has come up with a test condenser to study fundamental design problems. Spacing, laning, vibration, steam pressure drop, and baffling will be studied on full-scale basis by varying tube configurations and tube sizes. Initial tests achieve 276 sq ft effective area with 250 tubes ⅝-in. in diam

Destruction test showing driven steel H-beam piles suitable for Chicago Loop building foundations has been completed for U. S. Steel by Armour Research. The H-pile was driven 105 ft to bedrock and subjected to more than 800 tons of load before failure occurred. Such 14-in., 117-lb-per-ft beams should cut Loop foundation costs

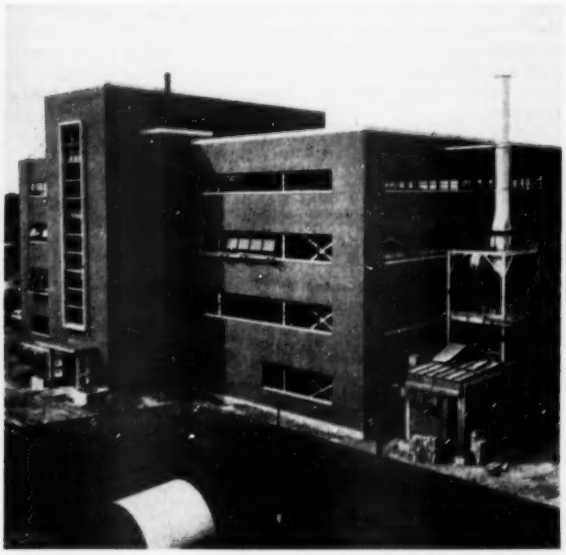
Traveling exhibits of Stephens-Adamson loaders, car pullers, winches, and other materials handling items are housed in this mobile display unit, shown emerging from an overnight stop in a limestone excavation. Power to operate exhibited equipment is generated by a unit on the tractor

M-G room at GE's new medium transformer plant at Rome, Ga. Generators rated 1000 kva at 2400 v and 60 cycles feed through transformers in background to test facilities bay (left)

Sound testing lab at GE's Pittsfield plant is nearly finished. Sound chamber inside is insulated by concrete, masonry and copper walls and echoes are killed by specially-designed fiberglas wedges for transformer noise studies

Worthington's Harrison Works has completed and placed in service this flexible hydraulic test lab. Intended primarily for performance testing, it will also be valuable for applied research and/or development activities

Development and testing of steam and gas turbines, heat transfer apparatus, compressors, and associated equipment will be the goal of this new laboratory just erected at the Westinghouse Steam Division's S. Philadelphia plant



Power Engineering Refresher . . . A-C Generators in Parallel

By H. A. DE BONNEVAL

FIRST LET US REVIEW the fundamentals of parallel operation of generators in order to apply the principles to an extensive distribution system.

1. The terminal voltage of each generator must be equal or brought to bus voltage through a transformer, Fig. 1.

2. The generators must have the same frequency and similar wave shape. Different wave shapes will build up a voltage harmonic producing internal circulating currents.

3. The generator to be connected to the bus must be in synchronism with the line, i.e. the wave voltage of the generator and the bus must be in phase, and polyphase machines must have the same phase sequence. This is done by adjusting the speed of the incoming machine and noting the difference in phase voltage between the bus and the generator, either by incandescent lights or preferably by a synchroscope.

4. A.C. generators, in order to operate satisfactorily in parallel, must have prime movers with drooping speed-load characteristics. Figure 2 shows two generators connected in parallel with the speed load curve of each prime mover. The vertical line of the graph indicates the frequency or electric speed rather than the rpm, for, as we have stated, the frequency must be the same. Accordingly, a two-pole 3600 rpm and an eight-pole 900 rpm generator have the same electric speed or frequency.

At this point, it is well to emphasize the fact that, though the load between d-c generators can be divided by altering the field strength, with a-c generators the load cannot be changed by altering the field. To change the kw output on a-c generators, the governing device on the prime mover must be adjusted. Let us assume that it is desired to increase the load of Generator 1 and reduce that of Generator 2. The speed load characteristic of Gen 1 (graph figure 2) is raised as shown in Fig. 3. Both of these generators are now delivering loads at a higher frequency. But as it is essential that the bus frequency be maintained at a fixed point (usually 60 cycles) and constant, it will be necessary that the speed load characteristics of Gen 2 be lowered at the same time as the speed load characteristics of Gen 1 are raised. This will be further covered when governor characteristics are analyzed.

Once generators are operating in parallel, they are in synchronism; that is, any changing condition tending to throw generators out of parallel will be counteracted by internal reaction opposing this tendency.

Figure 4 is a vector diagram of machines operating in parallel. Both voltages of the machines are equal and opposite so that the voltage acting in the local circuit is zero, and consequently no current is flowing in the circuit. Two generators operating in parallel must have the same average frequency, but one may momentarily run ahead or drop behind the other due to a sudden change in load. Should Gen 1 speed up slightly, the frequency will change and the voltage vector will move ahead of its normal position by angle a, shown as E_{1a}. The vector sum of the two generators is no longer zero, but a quantity indicated vectorially as E_o.

Under average circumstances, the circulating current I_o lags the voltage E_o angle B, by nearly 90 deg, because the resistance of a generator is very small in proportion to its reactance.

It will be observed in Fig. 4 that I_o is nearly in phase with voltage E_{1a}. Therefore a power load is placed on Gen 1 tending to slow it down; while I_o is nearly 180 deg from the voltage vector E_2 of Gen 2, causing an induced emf in opposition to the current, thus creating a motor action to speed up Gen 2.

Consequently, if alternators in parallel attempt to pull out of step, a circulating current between the machines is set up which tends to retard the leading machine, while accelerating the lagging machine, and thus prevent the machines from pulling out of synchronism. This current I_o is called the synchronizing current.

It has been previously stated that changing the field current does not affect the load output of the generator. If two generators are operating in parallel, but have their field adjusted to give the same terminal voltage, a reactive current will flow between the generators to compensate any difference in electric characteristics between the machines.

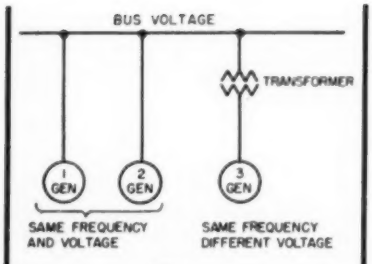


FIG. 1

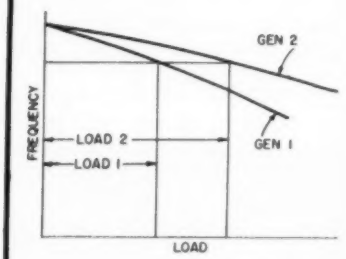


FIG. 2

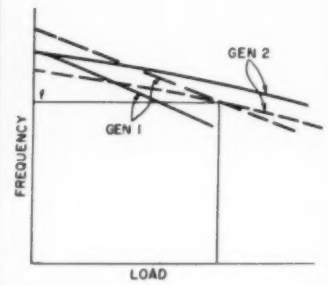


FIG. 3

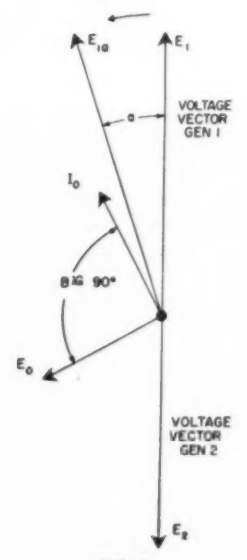


FIG. 4

Figs. 1 to 4. Diagrams, explained in text, showing how a-c generators in parallel automatically try to remain in step when their loads are increased

Figure 5 shows the vector diagram for two generators delivering current with a common terminal voltage. Assuming that both machines have the same resistance R and reactance X, their internal voltages E_1, E_2, will be the same.

Let us now weaken the field of Gen 1 and strengthen the field of Gen 2. The internal voltage of Gen 1 will decrease and the internal voltage of Gen 2 will increase. But both machines being connected to a common bus must continue to have equal terminal voltage.

The reduced internal voltage of Gen 1 is shown in Fig. 6 as Vector E_1. Vector E_2 is shown of greater magnitude to indicate the increased internal voltage of Gen 2.

It is known that when the load power factor is unity, the terminal voltage V is in phase with the current I in the armature. The IR drop in the armature is in phase with the current. The IX drop leads the current by 90 deg. The impedance drop of the generator is the vectorial sum of IR and IX, thus establishing the resultant vectorial sum E_1 which represents the induced emf or internal voltage of the generator. It is well to point out that IR and IX are two voltage drop components of E_1 which are necessary to overcome to give the terminal voltage. A review of this fundamental is important to help us analyze the change in internal emf of a generator when current leads or lags.

When the current lags the terminal voltage, as shown in Fig. 7, that is when we are operating at other than unity power factor, which is usually the case, the current vector takes the position shown in Fig. 7. The current is shown lagging by the angle θ. The vectors of the impedance triangle remain the same in magnitude as the internal characteristics of the machine remain the same, but the IR drop being in phase with the current, the whole impedance triangle revolves so that the IR vector is parallel to the current vector.

It is now evident that due to a lagging current the internal voltage E_1 will be larger than when the current was in phase. Thus, by inspection of Fig. 7, it will be seen that for a fixed value of internal emf, the terminal voltage will decrease with an increase in the lag of the current even though the value of the current remains the same. Consequently, as the current lag increases, the impedance triangle will continue to revolve with it. The current lags the internal voltage E_1 by the angular value θE.

In cases where the current leads the terminal voltage, it will be noted from the vector diagram Fig. 8 that the induced emf — internal voltage — will decrease. The impedance triangle now swings in a counterclockwise position about the end of vector V.

At unity power factor, the internal resistance drop is the important factor in determining the internal emf, but as the power factor increases the reactance drop becomes the important factor. The larger the power factor, the poorer the regulation.

It has been shown that a leading or lagging current will increase or decrease the induced emf when a constant terminal voltage is maintained. Accordingly, a stronger or weaker field is required to maintain a constant terminal voltage. The load cannot change in phase or in quantity, as this is determined by the system load demand.

The current of Generators 1 and 2 will adjust this magnitude and phase relation so that the vector sum is equal to the current of the system load, Fig. 6. It is to be noted now that each machine is delivering a current greater than when the induced emf was equal. Therefore, the I^2R loss of each machine will be greater, with a corresponding decrease in efficiency.

It is obvious from the above that the cross current is to be kept at a minimum. These cross currents will register on the ammeter of each of the generators. Thus, if the field of each generator is so adjusted that the sum of the ammeters is a minimum, the cross current is reduced to zero. Unequal internal voltages will cause current flow between generators at no load. The power factor and the resultant kva of a generator in parallel with others are determined by the amount of the field current as well as by the kw load output. The phase angle between bus sections becomes important when a station is supplying a network system and should be kept to a minimum to prevent circulating currents through the network.

In a subsequent article we will discuss the practical application of these principles to show how frequency and load are controlled in stations which operate in parallel on a complicated network.

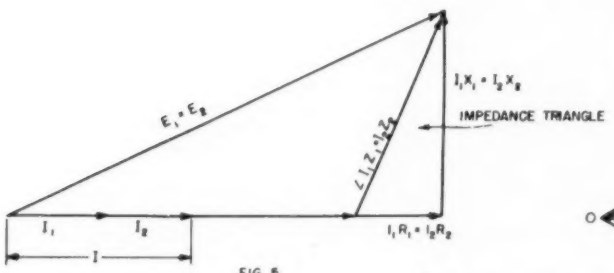


FIG. 5

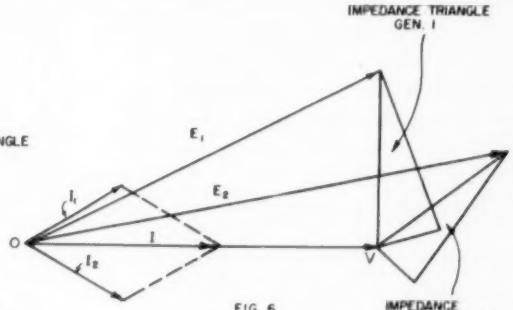


FIG. 6

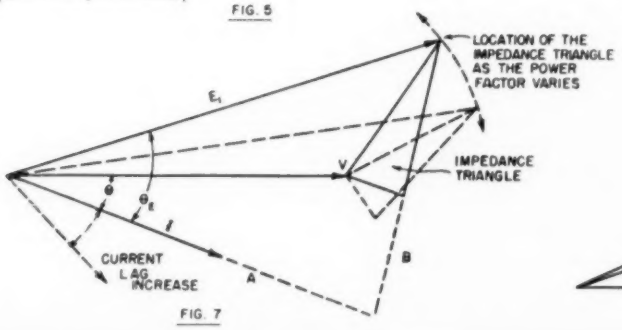


FIG. 7

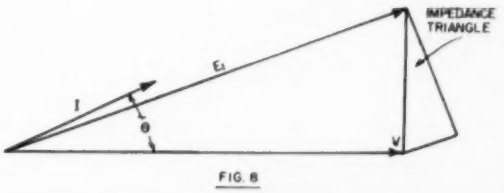


FIG. 8

Figs. 5 to 8. Vector diagrams showing how the electrical characteristics of a-c generators determine their behaviour under load when they operate in parallel

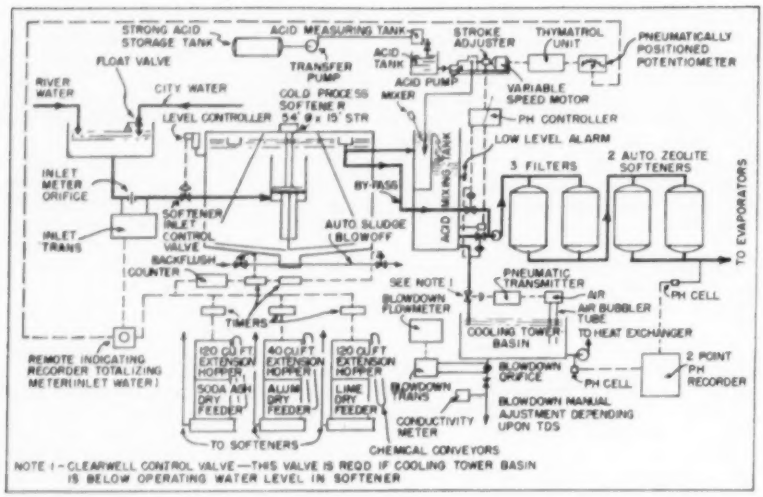


Fig. 1. Flow diagram of cooling tower and feedwater make-up treatment plant in a Western utility. The cold process water softener provides a sludge blanket to reduce oil, organic matter and turbidity

Removing Oil from Water By Flocculation and Filtration

By V. J. CALISE *

Treatment of surface water supplies, condensate and feedwater make-up for the removal of oil is considered here as a problem for sludging, settling and filtering. Specific, actual cases are cited to show how it is done by flocculation and filtration in a chemical plant and utility

* Director, Research and Development, Graver Water Conditioning Company.

IN MANY parts of the country, the discharge of waste waters containing oil and petroleum products has been a serious source of pollution of surface water supplies. This has complicated the problem of treating surface supplies for removal of oil and other impurities so that these clarified supplies can be used for process, cooling water and boiler feedwater purposes in the plant after further supplementary treatment.

In many plants it is desirable to recover and re-use oily condensate and exhaust steam because it contains large amounts of heat energy and is a source of low-solids boiler feedwater. In the latter case, recovery would mean less high-solids make-up for the feedwater system.

Finally, many refineries require treatment of their waste waters before discharging them into open streams because of their high concentrations of petroleum compounds. This frequently involves both mechanical and chemical methods of removal for emulsified and insoluble oily compounds, and for so-called water-soluble refinery wastes.

This article presents information on some of the current methods employed to treat several of these types of waters by means of sludge absorption and settling, and includes the chemical laboratory data required for original evaluation and design of equipment. Specific operating data from actual installations is given. A second article will deal with the problems peculiar to the recovery and re-use of waste waters normally discharged.

Several years ago, a utility station in the West was constructed to operate on a highly contaminated river water supply. Treated and clarified water was required for cooling water make-up to recirculating cooling towers, operating the turbine condensers, for boiler feedwater make-up, and for general plant use. A spot analysis of the water to be treated at the time of plant design showed a composition as reported in Table I.

Tests were made in the laboratory on this single sample to check the optimum method of treatment, and it was found that 190 ppm of hydrated lime (93 per cent purity), 70 ppm of soda ash and 24 ppm of alum were required to produce a good floc which settled in less than five minutes. No chlorine was used in these original tests, and oily wastes were not expected in this river supply. Records of the river water analyses over the past years indicated that this was a fairly typical river water analysis at its worst condition.

Based on these records and the preliminary test made on the river water sample, and based as well on the availability of a separate well supply, a conservatively designed water-treatment plant was installed at this station. Fig. 1 shows a flow sheet of this installation. About 3000 gpm of water flows by gravity from head tanks to a sludge-contact-type cold process water softener (54 ft in diameter), and chemicals are

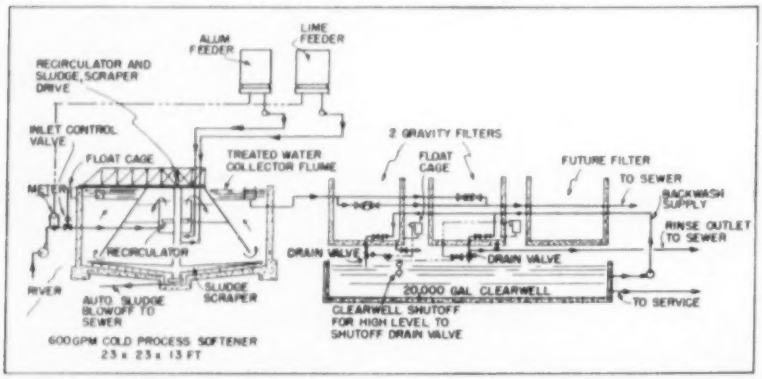


Fig. 2. Soluble and insoluble oil in swamp-settled water supply are removed by this sludge contact clarification plant. Clarified effluent passes through pressure zeolite softeners prior to its use

Table I. Spot analysis of a Western utility's water

Cations *		Anions *	
Ca^{++}	= 340	HCO_3^-	= 200
Mg^{++}	= 228	SO_4	= 390
Na^{+}	= 366	Cl^-	= 344
Totals	= 934		= 934

* Expressed in ppm as $CaCO_3$

Turbidity = 70 ppm as SiO_2
Organic Matter = 80 ppm by permanganate test
Oil measured by ether extraction = 2 ppm

Table II. Beaker tests on Western utility's water supply showing effect of chemical dosages and of sludge contact on settling time; also shown is water analysis made about 19 months after that given in Table I

Analysis of Raw Water		
Cations*	Anions*	
Ca^{++} = 312	HCO_3^- = 254	Oil = 40 – 50 ppm
Mg^{++} = 374	SO_4^{--} = 596	Turbidity = 200 – 350 ppm
Na^+ = 574	Cl^- = 410	Organic Matter = 80 – 100 ppm
Total = 1260	Total = 1260	*Expressed in ppm as $CaCO_3$

Effect of Dosages and Sludge Contact

Sample No.	Lime ppm	Alum ppm	Soda Ash ppm	Sludge Added*	pH	TH	Effl. Sample Analysis—After 5 Minutes Resin Settl. M.O. Alk.	P Alk.	Turbid. ppm	Oil ppm	Organic Matter ppm
1	300	40	1010	——	9.7	530	70	30	hazy	1.0	3–5
2	360	90	10	——	10.2	502	60	30	clear	1.0	3–5
3	360	90	10	1000	10.4	490	45	23	clear	0.2	3
4	400	100	10	——	10.6	470	60	30	hazy	1.0	3
5	300	50	10	1000 & 5 ppm Cl_2	10.2	485	45	23	clear	<0.2	<1

Table III. Beaker tests on swamp-settled water supply for chemical plant, showing effect of optimum pH and coagulant dosages on the removal of oil; also shown is the analysis for the raw river water supply

Analysis of Raw River Water		
Cations*	Anions*	
Ca^{++} = 50	HCO_3^- = 50	Oil = up to 10 ppm
Mg^{++} = 25	Cl^- = 20	Turbidity = 15 – 20 ppm
Na^+ = 75	SO_4^{--} = 80	Organic Matter = 40 – 100 ppm
Total = 150	Total = 150	*Expressed in ppm as $CaCO_3$

Effect of Optimum pH and Coagulant Dosages on Removal of Oil

Jar No.	ppm Alum	Lime	Copperas	Clay	ppm REC	Cl_2	SiO_2	Character of Floc	Settling Time of Floc (min.)	Settled pH	Settled Turbidity	Oil ppm
9		0	—					No Floc		7.1	No Floc	—
10		9	34					No Floc			No Floc	
11		17	34					No Floc			No Floc	
12		25	34					No Floc		8.5	No Floc	
13		0	34			10		No Floc		6.5	No Floc	—
14		17	34					No Floc		6.7	No Floc	
15		34	Suspended Sludge —1000 ppm			10		Good	3	8.3	No Floc	
16	2	25	Suspended Sludge —2000 ppm			10		Excellent	<3	8.0	<5	<0.2
17	2	34	Suspended Sludge —2000 ppm			10		Excellent	<3	8.2	<5	<0.2
18	2	25					2	Good	4	8.3	5	<0.2
19	2	34					2	Excellent	2	8.9	<5	<0.2

fed with preformed suspended sludge and raw water to complete chemical reactions quickly. Subsequent treatment is with acid and glassy phosphate for stabilization, followed by discharge. About 2800 gpm of unfiltered water is used as make-up to the cooling tower basin and 100 gpm is filtered in pressure filters and softened in styrene-base sodium zeolite automatic softeners.

About 19 months after the original design work was completed, the treatment plant was installed. A second study of the river water, conducted at the time of this installation in December 1951 to January 1952, showed that river solids were running from 30 to 50 per cent higher than reported in the original data. This variation in oil, organic matter and turbidity is as follows:

1. Oil concentration by ether extraction, 10–50 ppm.

2. Total organic matter by permanganate, 50–200 ppm.

Table IV. Condensate oil removal by preformed floc filters. Data is taken from four installations

Plant No.	Max. Emulsified Oil in Raw Water (ppm)	Alum Floc Fed (ppm)	Max. Flow (gpm)	Max. Oil in Treated Condensate (ppm)
1	30–40	20	1000	1.0
2	8–10	4	75	0.2
3	10–15	3	100	0.2
4	4–5	2	85	0.2

3. Turbidity, 80–350 ppm as silica units.

Laboratory beaker tests were made by the field engineer to check various optimum chemical conditions for operation, and Table II shows some of the typical results. They, in turn, showed the following:

1. The need for substantially increased dosages of chemicals over and above the stoichiometric values.

2. The beneficial action of contact with as low as 1000 ppm of $CaCO_3$ sludge in the form of 200 fine mesh precipitate.

3. The beneficial action of 5 ppm of chlorine in reducing organic matter.

In actual operation, the cold process softener produces less than 10–20 ppm of turbidity even at the highest pollutional loads with 15–25 minutes contact with about 5000 ppm of sludge precipitates and 5 ppm of chlorine. (The break-point dosage of chlorine is 40–50 ppm.) Contact with sludge in the softener (which is provided by precipitation of $CaCO_3$ and some $Mg(OH)_2$) as well as slight chlorination permitted reduction of oil, organic matter and turbidity to very low values in the large unit.

An Eastern chemical manufacturer recently installed a 600 gpm sludge contact clarification plant operating on swamp-settled Delaware River water. A flow sheet of this plant is shown in Fig. 2. Gravity filters are provided, and pressure zeolite softeners treat the clarified effluent to produce process water and boiler feedwater make-up.

On initial installation, tests with the river water showed up to 10 ppm of insoluble oil as well as soluble sulfonated oils present in the river water. Presettling in a swamp increased organic matter content of the water, but decreased turbidity to less than 20 ppm most of the time. Table III gives a summary of results with beaker tests at the time of installation. These results, in turn, indicated the following:

1. The beneficial action of 1000 ppm of suspended sludge, mainly $Al(OH)_3 \times H_2O$, plus some slight amounts of $CaCO_3$ at a pH above 8 in producing *continued on page 110*

Hanford Now Utilizes Waste Heat from Reactors

Utilization of waste heat in reactor cooling effluents means the Columbia River will be a little cooler, taxpayers will be better off by about $56,000 per year, and power engineers who respect the expensive Btu will be pacified for a little while

FOR SOME TIME NOW, power engineers have objected to the waste of heat developed by the big Hanford atomic reactors. Standard practice has been to cool the reactors with water from the Columbia River, then dump the water back into the river laden with very expensive heat and traces of radioactive mineral. At last, the AEC is going to put that heat to work heating the buildings comprising the Hanford plutonium producing project.

Initial investment for the heat recovery system is estimated at $614,000. Its annual operating cost (excluding repairs) is estimated at $2,200. Annual fuel savings will amount to about $56,000 — enough to pay off in 7½ years the $444,000 difference between the cost of a conventional steam system and the heat recovery system.

Charles T. Main (architect-engineers) and G.E. engineers collaborated to design the system. G.E. is operating the plant for the AEC. While several buildings will be heated by the one system, about half the recovered heat will go to the main structure housing a production reactor which is now under construction.

Two-Stage System

Water from the Columbia River, of course, contains dissolved mineral matter and this becomes slightly radioactive as the water is pumped through the reactors. A second circuit, presumably using distilled water, picks up the heat from the contaminated water in the main exchanger (see illustration) and carries it safely to the air conditioning system. Radioactive water is discharged back to the river, where the radioactivity disperses and decays rapidly.

Constant air flow is maintained across the reactors to the outside to prevent radioactive dust particles from being carried into the working areas. Consequently, none of the air is recirculated and reheated, but is inducted, cleaned, heated, and poured through the buildings to the outside. This circulation requirement makes impractical the possibility of piping the hot water directly through the walls to heat the buildings by radiant heating.

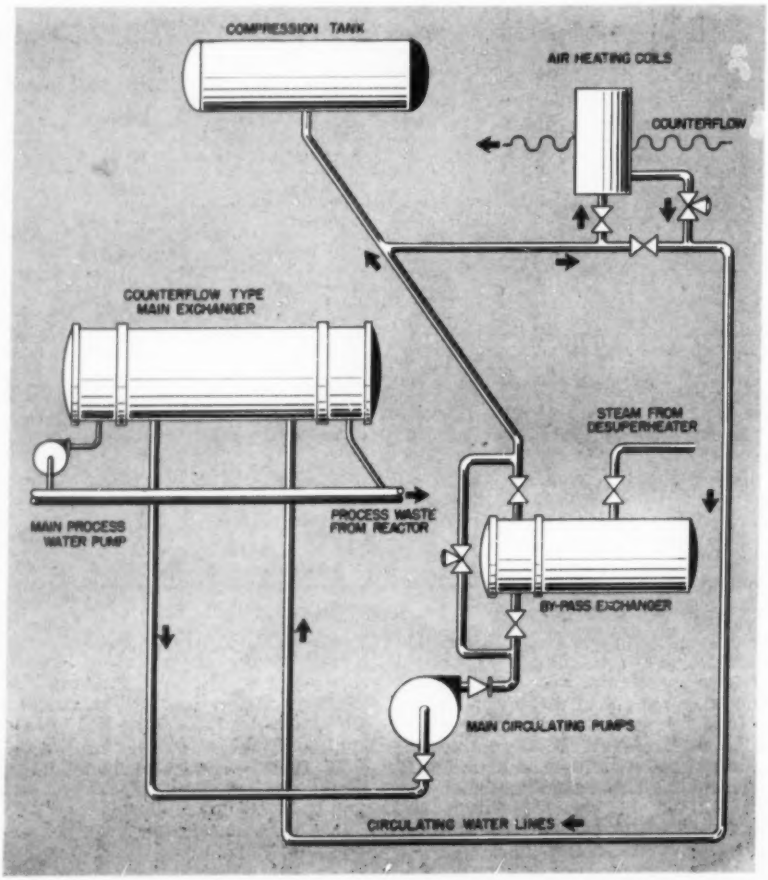
By-Pass Exchanger

Three major elements plus piping comprise the recovery system. The primary (main) exchanger transfers heat from the contaminated effluent to the intermediate fluid. Secondary exchangers (air heating coils) transfer heat from the intermediate fluid to air. A by-pass exchanger heats the intermediate fluid with steam when the reactor is shut down.

A central station supplies steam to the by-pass exchanger upon demand, but the primary purpose of the steam plant is to supply emergency electrical power to the plant in the event of power failure. No extra capacity for heating was considered in installing the steam generators.

All piping in the system is subsurface and is not insulated, since the reactors supply abundant heat and that heat is at low temperature. Losses to the ground are considered negligible.

Installation of the recovery system will end much of the heat waste which has been going on since September, 1944.



Schematic flow diagram of the heat recovery system at the AEC's Hanford, Washington, plutonium plant

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Contents

Snorkel and Aftercooler Dry Control Air 90
Basic Power Plant Figuring—Water Flow and Losses in Small Piping 92, 94
Air Compressor Destroys Itself 96
Bad Tuyeres Cause Smoke, Stifle Fire 96

Snorkel and Aftercooler Dry Control Air

By WALTER J. STEINERT

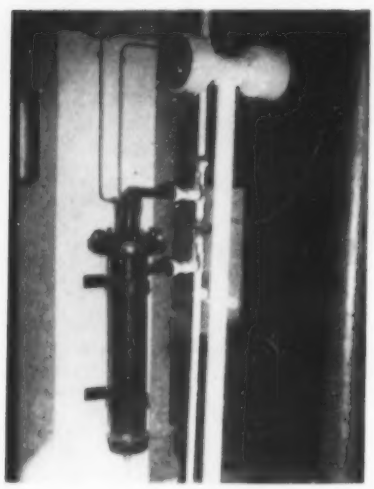

Fig. 1. Snorkel and aftercooler, both home-made, are mounted on the operating floor. Aftercooler uses aspirator water for coolant, can be by-passed

IN OUR PLANT we use compressed air only for the air-operated combustion control system, and two 2-stage "Y"-type compressors rated at 25 cfm fill our needs. From the very beginning, however, we were troubled with excessive moisture in the lines and this (despite numerous traps) carried over into the control system. This caused sluggish operation, and at times made it entirely inoperative.

Both compressors are located in a hot, humid basement and it was not practical to move them. In an attempt to solve our problem by securing a new air supply, we built a "snorkel" (see Fig. 1) to pick up air from the operating floor. The air filters were installed in a tee about 7 ft above the operating floor, and an insulated line was run through the floor to the compressors.

Though some improvement was noted, we still had plenty of moisture — especially in humid weather. Obviously, we needed an aftercooler.

Our combustion control people informed us that when the plant was built, in 1948, they considered an aftercooler to be unnecessary in small plants such as ours. Today they are recommending them for all plants, regardless of size. They submitted a list of manufacturers who wanted $500 for an aftercooler, and even by shopping around, the best price I could find was $250.

Home-made Aftercooler

So off to the scrap heap I went. The resulting cooler (Fig. 2) was admittedly experimental, was not carefully calculated and designed, and it was built of materials on hand.

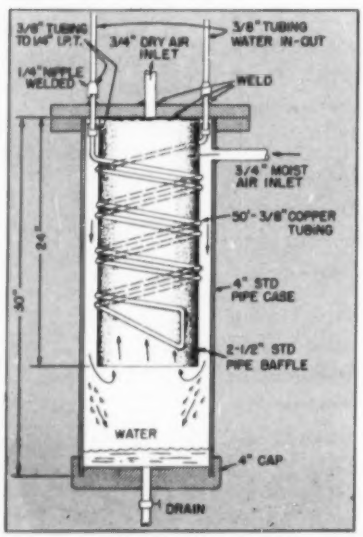

Fig. 2. Steinert's $15 aftercooler. It is made of scrap pipe plus purchased tubing and fittings

For the outer casing I used a piece of 4-in. pipe 30 in. long. One end was threaded and received a screwed flange. The other end was closed with a 4-in. cap, drilled and tapped for a $\frac{1}{4}$-in. drain. A piece of $\frac{1}{2}$-in. plate was cut to match the flange, and the inside or "baffle" pipe ($2\frac{1}{2}$-in.) was welded to this plate. The baffle pipe was to cause the air to flow down the sides in close contact with the coils without shorting across to the outlet.

The cooling coil is formed by winding 50 ft of $\frac{3}{8}$-in. copper tubing around the baffle pipe in a spiral as shown in Fig. 2. The $\frac{3}{8}$-in. cooling water inlet and outlet nipples as well as the $\frac{3}{4}$-in. dry air outlet nipple are welded into the flange plate. A $\frac{3}{4}$-in. nipple is welded to the casing pipe for the admission of moist air. Originally, I had planned to put filter material inside the baffle pipe, but we had no oil problem so left it out.

The aftercooler is connected into the original air line with a 3-valve by-pass to permit servicing if it becomes necessary. Cooling water was obtained without increasing consumption by using that going to the CO_2 recorder's aspirator. The flow is 3 to 6 gpm, which proved sufficient.

Near-Perfect Performance

In the finished cooler, moist air is admitted through the side of the outer case near the top, is forced downward in close contact with the cooling coil, reverses direction at the bottom (slinging out moisture), and passes through the inside of the baffle pipe and out through the dry air pipe.

Results were amazing, considering the haphazard design. We cut it in on a hot, humid day and let it run 24 hours before draining. We opened the drain and nearly a bucketful of water came out. We now blow it out once each shift and the efficiency is nearly 100 per cent.

Since the aftercooler was made from scrap, the only real cost was for 50 ft of copper tubing and a few fittings. The total cost was $15.

Trying to reduce piston packing maintenance?

J-M Pump Cups after removal from feed water pumps at Morgan Laundry. Set above consists of 2 J-M "A" Cups with spacer and 2 followers, mounted on pump rod

At the Morgan Laundry, J-M Moulded Packings provide

"8 times longer life– replacement in 1/6 the time"

THE MORGAN LAUNDRY, large supplier to hotels and institutions, requires dependable, trouble-free service from boiler room equipment. In their New York City plant, the Engineering Department found that conventional piston packings for boiler water feed pumps lasted only a relatively short time. Many hours of down time were required to replace packings. Liner wear became progressively worse.

When the Engineering Department changed from the conventional material to J-M Moulded Packing Cups, service life of the packing was increased more than 8 times. Liner wear was greatly reduced. Replacement with the new packings was made in 1/6 the time. Packings could be easily installed for proper service, without special skill or experience. Satisfaction with this application has led to the use of J-M Moulded Packing Cups on other boiler room equipment and on presses in the Morgan Laundry plant.

These precision moulded packings offer definite advantages over conventional types. Because they form a highly efficient seal, they contribute to improved performance, lower operating and maintenance costs. For steam pump pistons, they are available in sets consisting of two cups and two followers, with a spacer. This pump cup set, J-M Style 80, is similar to that shown in the illustration above.

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Basic Power Plant Figuring

. . . . . Water Flow and Losses in Small Piping

A Review for Old-Timers – A Must for Young-Timers

By **WILLIAM H. ENGELMAN** *

THIS ARTICLE presents the fundamental data for the calculation of flow and losses in pipes between ⅛- and ¾-in. nominal diameter.

1. What is the flow of water per minute or per hour?
2. What size pipe is required?
3. What is the total friction loss in pipe and fittings?
4. What is the available or required initial pressure?
5. What is the final pressure required?

Nomenclature and Units in Table I:

A Flow of water in gallons per minute, gpm.

B Flow of water in pounds per minute at 60 F; a gallon at 60 F is 8.337 lb; at 212 F it is 8.0 lb.

C Velocity of water in pipe in feet per second (fps) for a flow of gallons per minute as indicated under item A.

D Velocity head in feet, when water moves at a given velocity, is equivalent head in feet through which it would have to fall in a vacuum to attain that velocity. See the graph.

E Friction head in feet, at a given velocity of the liquid, per 100 linear feet or its equivalent, is head in feet necessary to overcome friction on surface of pipe and fittings. This loss of head caused between moving water and inner surface of pipe is a very important factor and usually exceeds the combined effect of all other losses.

F Friction head per 100 linear feet or its equivalent expressed in pounds per square inch (psi).

Values for water are taken as follows:

A cubic foot of water at 60 F equals 62.37 lb.

One gallon is 0.1337 cu ft and equals 8.337 lb.

One psi is 144 ÷ 62.37 or 2.309 ft head.

One foot head is 62.37 ÷ 144 or 0.4331 psi.

A column of water 2.309 ft high produces a unit pressure of 1 psi at its base and a column of water 1 foot high, a pressure of 1 psi at its base and a column of water 1 foot high a pressure of 0.4331 psi at the base.

Because of low cost, small pipe sizes for general use are mostly made by the butt-welding process. The ultimate tensile strength for internal fluid pressure is 40,000 psi. The simplest and most widely used empirical formula for internal fluid pressure is Barlow's formula, where:

P is bursting pressure, lb per sq in. (psi)
t is thickness of pipe wall, in.
S is maximum tensile strength, psi.
O is outside diameter of pipe, in.

$$P = \frac{2\,t\,S}{O} \qquad S = \frac{P\,O}{2\,t} \qquad t = \frac{P\,O}{2\,s}$$

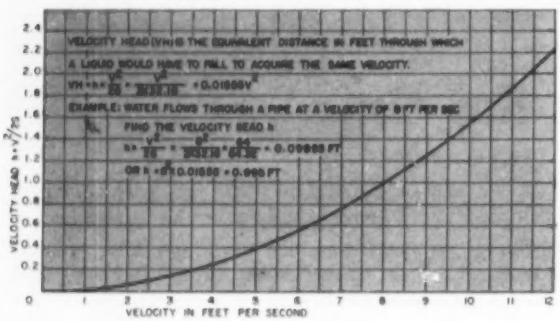
While this formula is not theoretically correct, it is within the limits met in piping practice.

Safety factor of 6 is a conservative figure for the allowable working pressure with steady flow. If the piping is exposed to sudden stresses by irregular flow, the safety factor may be increased to 8 or 10.

If the maximum tensile strength S should have a value of 50,000 psi, P could be increased by 25 per cent.

* Mechanical Engineer, Cleveland, Ohio. All re-publication rights reserved by author

Graph for water showing velocity head in feet and velocity in feet per second


VELOCITY HEAD (VH) IS THE EQUIVALENT DISTANCE IN FEET THROUGH WHICH
A LIQUID WOULD HAVE TO FALL TO ACQUIRE THE SAME VELOCITY.
EXAMPLE: WATER FLOWS THROUGH A PIPE AT A VELOCITY OF 8 FT PER SEC.
FIND THE VELOCITY HEAD h
VELOCITY HEAD h = v²/2g
VELOCITY IN FEET PER SECOND

Example 1. A ½-in. Schedule 40 pipe discharges 6 gal of water per min. What are the respective values for item B to F inclusive?

B. 6 × 8.337 = 50.0 lb of water per minute.

C. $v = \frac{24.51 \times G}{60 \times d^2} = \frac{24.51 \times 6}{60 \times .3869} = 6.33$ ft per sec

D. $h = \frac{v^2}{2g} = \frac{6.33^2}{2 \times 32.16} = \frac{40.07}{3.869} = .062$ ft

E. From table 1 is 41.0 ft head loss per 100 ft of pipe.

F. 41.0 × 0.4331 is 17.8 psi pressure loss per 100 ft of pipe.

Example 2. A hydraulic press is supplied with 8 gal of water per min through a ½-in., Schedule 40, pipe 20 ft long. In the run is one swing check valve, one globe valve, and one 90-deg elbow.

a. Calculate the friction head in feet.
b. Calculate the pressure drop in psi.

* Equivalent length for swing check valve	4.0 lin ft
* Equivalent length for globe valve	17.0 lin ft
* Equivalent length for 90-deg elbow	1.5 lin ft
Equivalent length of pipe	22.5 lin ft
Run of pipe	20.0 lin ft
Total	42.5 lin ft
Friction for pipe and fittings is 42.5 × 70 ÷ 100 or	29.75 ft
The velocity head h required at header is	1.11 ft
a. Total friction head	30.86 ft

b. Pressure drop is 30.86 × 0.4331 or 13.37 psi.

* Values taken from Resistance of Valves and Fittings to Flow of Fluids by Crane Co., Technical Paper No. 409, Figure 17, page 21.

Example 3. A ½-in. Schedule 40 pipe has an equivalent length of 100 ft. It delivers 9 gal of water per min at a final pressure of 1500 psi. Using the values from the tables, find:

a. The total friction in pounds.
b. The initial pressure required.
c. Is the pipe of ample strength?

From item D, the velocity head is	1.4 ft
From item E, the friction loss is	86.0 ft
Total friction loss is	87.4 ft

a. 87.4 × 0.4331 is 38.0 lb friction loss.
b. Initial pressure is 1500 plus 38 or 1538 psi req'd.
c. Allowable pressure is 1733 psi with a safety factor of 6.

Actual safety factor is 10.400 ÷ 1538 is 6.8

Example 4. How many ¼-in. Schedule 40 pipe will equal the area of one ¾-in. Schedule 40 pipe?

For a ¾-in. Schedule 40 pipe, d^2 is 0.6790
For a ¼-in. Schedule 40 pipe, d^2 is 0.1325
and 0.6790 ÷ 0.1325 is 5.1 — ¼ in. pipes in area.

Example 5. Using Schedule 40 pipe, how many ¼-in. pipes will equal the discharge capacity (flow) of one ¾-in. pipe?

$d^{2.5}$ is 0.6163 for the ¾-in. pipe.*
$d^{2.5}$ is 0.0799 for one ¼-in. pipe.*
and 0.6163 ÷ 0799 is 7.7 — ¼-in. pipes equal the flow.*

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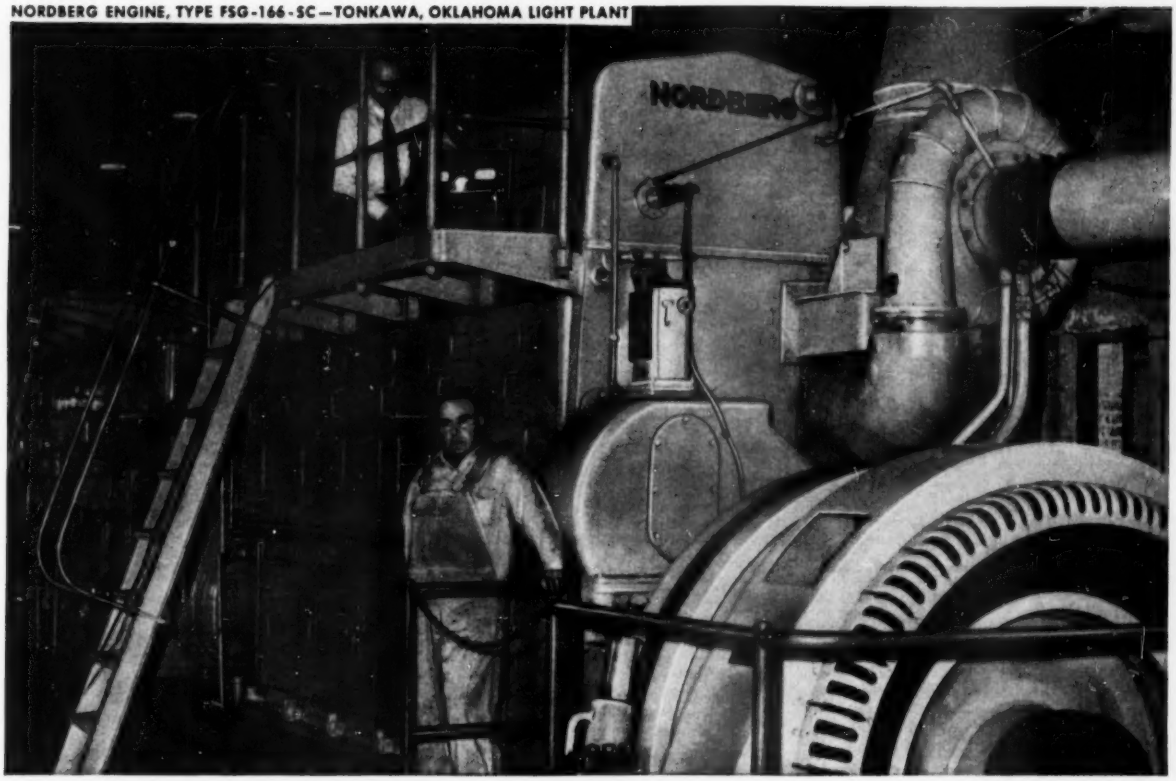

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LINER MEASUREMENTS		WITH CRANK	90° TO CRANK
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	4" down	.003"	.006"
	8" down	.0035"	.007"
#2 Liner	Top	16.003"	16.002"
	4" down	.002"	.001"
	8" down	.001"	.0005"
#3 Liner	Top	16.005"	16.007"
	4" down	.004"	.006"
	8" down	.003"	.008"
#4 Liner	Top	16.003"	16.004"
	4" down	.004"	.005"
	8" down	.001"	.002"
#5 Liner	Top	16.004"	16.000"
	4" down	.003"	.000"
	8" down	.003"	.001"
#6 Liner	Top	16.003"	16.0015"
	4" down	.0015"	.0015"
	8" down	.0015"	.0005"
(Original machine shop tolerance—16" plus or minus .001")			

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They were so amazed that they had another man in the plant take his own micrometer readings. Still not certain that an engine could run that long with so little wear, they had the micrometer itself checked! The instrument checked out perfectly!

Men who have worked with Diesel Engines all their lives have said that they've never seen an engine with that much time in service with so little wear. Obviously, a great deal of the credit must go to the maker of these splendid engines, but also, credit must be given to the high-quality, wear-reducing Cities Service Diesel Oils used in this engine. You'd be wise to buy yourself this kind of inexpensive diesel-engine protection too. Call your nearest Cities Service Office or write Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

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Example 6. What is the bursting pressure and the allowable working pressure for a ½-in. Schedule 40 pipe? Outside diameter is 0.840-in., wall thickness 0.109 in., and the safety factor 6.

t is 0.109
S is 40,000 $\quad P = \frac{2tS}{OD} = \frac{2 \times 0.109 \times 40{,}000}{0.840} = 10{,}400$ psi
O is 0.840

Allowable working pressure is $10{,}400/6 = 1{,}733$ psi

Example 7. Will a 1-in. pipe header have sufficient discharge capacity to supply: one ⅛, one ¼, one ⅜, one ½, and one ¾-in. pipe? All piping to be Schedule 80.

The sum of $d^{2.5}$ for ⅛ to ¾ inclusive is 0.8825
$d^{2.5}$ for 1-in. pipe is 0.8959

therefore the 1-in. pipe is ample.

Basing Problem 7 on pipe areas, it becomes a ratio of 1.165 to 0.9158, that is, the area of the 1 in. pipe is

0.9158 ÷ 1.1650 = 0.876 or 78.6% of the combined area of the pipes supplied.

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* Note:—In problem 5 it requires 7.7—¼-in. pipes to equal the flow of one ¾-in. pipe. This is due to the ratio of the flow area to the perimeter of the flow passage (wet perimeter.)

Wet perimeter of ¼-in. pipes is $7.7 \times 0.364 \times 3.1416 = 8.81$ in.
Wet perimeter of the 1-in. pipe is $0.824 \times 3.1416 = 2.59$ in.

References: Piping Handbook, by Crocker, McGraw-Hill Book Co.
Crane Co. Catalog, by Crane Co., Chicago.
Walworth Co. Catalog, Walworth Co., New York City.
Tube Turns Catalog, Louisville, Kentucky.
Cameron Hydraulic Data, Ingersoll Rand Co., New York.

Table I. Flow of water in pipe sizes ⅛ to ½, Schedule 40; values given are for clean pipe, properly installed, within reasonable operating accuracy limits

Pipe Size, In. and Sched. No.	Flow per minute		Velocity		Loss in 100 ft	
	Gallons	Pounds	Fps	h = Hd in Ft	Ft Hd	Psi
	A	B	C	D	E	F
	0.1	0.84	0.56	0.00	0.0	0.0
	.2	1.67	1.13	.02	4.4	1.9
	.3	2.50	1.69	.04	9.7	4.2
⅛	.4	3.34	2.26	.08	15.8	6.8
40	.5	4.17	2.82	.12	24.0	10.4
	0.6	5.00	3.38	0.18	33.5	14.5
	.7	5.84	3.95	.24	44.3	19.2
	.8	6.67	4.51	.33	57.0	24.7
	.9	7.50	5.08	.41	71.0	30.8
	1.0	8.34	5.64	.50	86.0	37.2
	.4	3.34	1.23	0.02	3.5	1.5
	.6	5.00	1.85	.05	8.0	3.5
	.8	6.67	2.47	.09	13.5	5.9
¼	1.0	8.34	3.08	.15	20.0	8.7
40	1.2	10.00	3.70	.21	28.2	12.2
	1.4	11.67	4.32	0.29	37.5	16.2
	1.6	13.34	4.93	.38	48.5	21.0
	1.8	15.01	5.55	.48	61.0	26.4
	2.0	16.67	6.17	.59	73.0	31.6
	2.2	18.34	6.78	.71	87.6	38.0
	.5	4.17	.84	0.00	1.0	.4
	1.0	8.34	1.68	.04	4.6	2.0
	1.5	12.51	2.52	.10	10.2	4.4
⅜	2.0	16.67	3.36	.18	16.7	7.2
40	2.5	20.84	4.20	.28	25.0	10.8
	3.0	25.00	5.04	0.40	35.0	15.2
	3.5	29.18	5.88	.54	47.0	20.4
	4.0	33.35	6.72	.70	60.0	26.0
	4.5	37.52	7.57	.89	75.0	32.5
	5.0	41.68	8.41	1.10	90.0	39.0
	1	8.34	1.06	0.02	1.5	.7
	2	16.67	2.11	.07	5.3	2.3
	3	25.00	3.17	.16	11.3	4.9
½	4	33.35	4.22	.28	19.2	8.3
40	5	41.68	5.28	.43	29.0	12.6
	6	50.00	6.33	0.62	41.0	17.8
	7	58.36	7.39	.85	54.0	23.4
	8	66.70	8.44	1.11	70.0	30.3
	9	75.00	9.50	1.40	86.0	37.2
	10	83.37	10.56	1.73	105.0	45.5

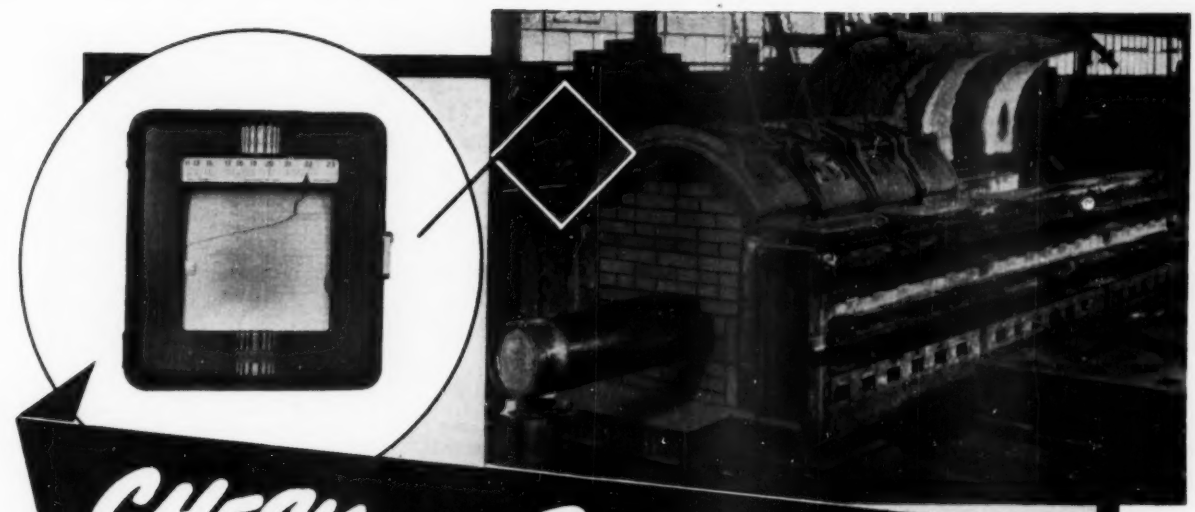
Table I (continued). Pipe size ¾, Schedule 40; and sizes ⅛ to ¾, Schedule 80

Pipe Size, In. and Sched. No.	Flow per minute		Velocity		Loss in 100 ft	
	Gallons	Pounds	Fps	h = Hd in Ft	Ft Hd	Psi
	A	B	C	D	E	F
	2	16.67	1.20	0.02	1.4	0.6
	4	33.35	2.41	.09	5.0	2.2
	6	50.00	3.61	.20	10.5	4.6
¾	8	66.70	4.81	.36	18.0	7.8
40	10	83.37	6.02	.56	27.1	11.7
	12	100.0	7.22	0.81	38.0	16.5
	14	116.7	8.42	1.10	50.0	21.7
	16	133.4	9.63	1.44	65.0	28.2
	18	150.0	10.83	1.82	80.0	34.7
	20	166.7	12.03	2.25	97.0	42.0
	0.1	0.83	0.88	0.01	0.4	0.2
	.2	1.67	1.77	.05	13.4	5.8
⅛	.3	2.50	2.65	.11	28.3	12.2
80	.4	3.34	3.54	.20	48.1	20.8
	.5	4.17	4.42	.30	72.4	31.4
	.6	5.00	5.30	.44	104.4	45.2
	0.4	3.34	1.79	0.05	9.2	4.0
	.6	5.00	2.67	.11	19.5	8.5
¼	.8	6.67	3.58	.20	33.2	14.4
80	1.0	8.34	4.48	.31	50.1	21.7
	1.2	10.00	5.38	.45	70.2	30.4
	1.4	11.67	6.27	.61	93.7	40.6
	.5	4.17	1.14	0.02	2.0	0.9
	1.0	8.34	2.28	.08	9.7	4.2
⅜	1.5	12.51	3.43	.18	21.0	9.1
80	2.0	16.67	4.57	.32	35.1	15.2
	2.5	20.84	5.71	.51	53.0	23.0
	3.0	25.00	6.86	.73	74.6	32.3
	3.5	29.18	7.99	1.00	98.7	42.7
	.5	4.17	.68	0.01	0.1	0.3
	1.0	8.34	1.37	.03	2.8	1.2
½	2.0	16.67	2.74	.12	10.2	4.4
80	3.0	25.00	4.11	.26	21.4	9.3
	4.0	33.35	5.48	0.47	36.5	15.8
	5.0	41.68	6.85	.73	55.2	23.9
	6.0	50.00	8.22	1.05	77.4	33.5
	7.0	58.36	9.59	1.43	103.0	44.6
	2	16.67	1.48	0.03	2.3	1.0
	4	33.35	2.97	.14	8.2	3.6
	6	50.00	4.45	.31	17.4	7.5
¾	8	66.70	5.94	.55	29.6	12.8
80	10	83.37	7.42	0.86	44.7	19.4
	12	100.0	8.90	1.23	62.7	27.2
	14	116.7	10.39	1.68	83.1	36.0
	16	133.4	11.87	2.19	106.5	46.1

Table II. Flow equivalent, bursting pressure, working pressure, and safety factor for Schedule 40 and 80 pipe installations from ⅛ to 1 in. diameter

Nom. Pipe Size, In.	Outs. Dia. OD	Pipe Wall t	Ins. Dia. d	d^2	$d^{2.5}$	Bursting Pressure 40,000#	Allow. Pressure S.F. = 6
Schedule 40 Pipe							
⅛	0.405	0.068	0.269	0.0724	0.0375	13,400	2,233
¼	.540	.088	.364	.1325	.0799	13,050	2,175
⅜	.675	.091	.493	.2430	.1707	10,800	1,800
½	.840	.109	.622	.3869	.3051	10,400	1,733
¾	1.050	.113	.824	.6790	.6163	8,600	1,433
1	1.315	.133	1.049	1.1004	1.1270	8,100	1,350
Schedule 80 Pipe							
⅛	0.405	0.095	0.215	0.4462	0.0214	18,750	3,125
¼	.540	.119	.302	.0912	.0501	17,640	2,940
⅜	.675	.126	.423	.1789	.1164	14,940	2,490
½	.840	.147	.546	.2981	.2203	14,000	2,333
¾	1.050	.154	.742	.5506	.4743	11,730	1,955
1	1.315	.179	.957	.9158	.8959	10,900	1,817

Values of the inside diameters squared, d^2, give the ratio of the cross-sectional areas of pipes.
Values of inside pipe diameters to the 2.5 power are the direct ratios of their relative discharge capacities. It is misleading and wrong to use area only for comparing pipe capacities. See the given example.



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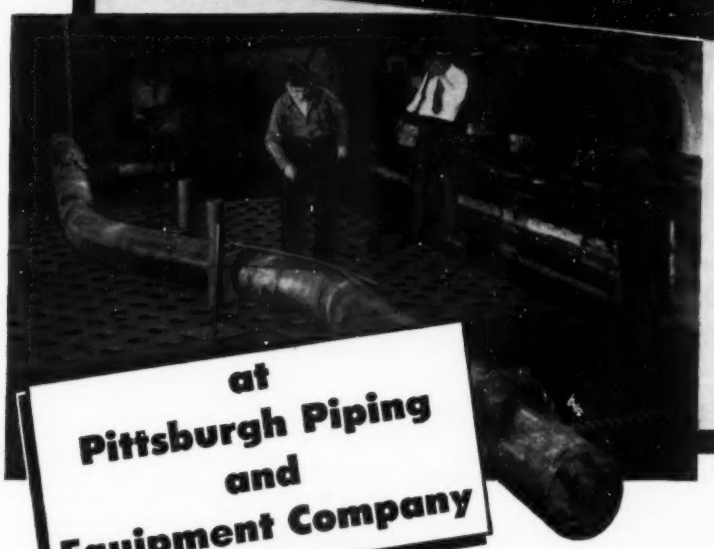

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on HEAT TREATING and BENDING TEMPERATURES

The temperature to which P.P.&E. piping is subjected before bending is measured by a Ray-o-Tube which projects through the furnace wall . . . and recorded on the chart of the Micromax instrument.

This time-temperature record makes practicable precise control of conditions so that each section of pipe is heated in conformance with a predetermined routine which assures consistent physical and mechanical properties.

After the pipe is taken from the furnace, it is immediately placed on a bending table, and during the bending process its temperature is periodically checked with an optical pyrometer by a trained, experienced observer.

You can depend on Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street — Pittsburgh, Penna.

Atlanta	Whitehead Building	Cleveland	Public Square Building
Boston	10 High Street	Houston	Heights State Bank Bldg.
Charlotte	221 Builders Building	Los Angeles	1930 N. Alexandria Ave.
Chicago	Peoples Gas Building	New Orleans	P. O. Box 78
New York	Woolworth Building		

PP-1

For more data circle 543 on Post Card

Air Compressor Destroys Itself

A little extra attention to that air compressor in your plant during the next scheduled overhaul might prevent a repetition of this catastrophe traced to the failure of a discharge valve

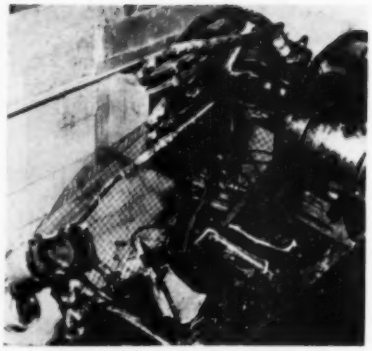


Fig. 1. Scene of self-destruction. Tank-mounted compressor suffered valve failure which resulted in piston seizure and more visible aftereffects shown

AT A MIDWEST steel casting plant less than an hour after the maintenance foreman had made a midmorning check of a six-cylinder air compressor and found it operating satisfactorily, the compressor tore itself to pieces.

It was not necessary to dismantle the compressor for examination, but examination of the remains revealed that a low pressure piston had seized in its cylinder. The cylinder had the appearance of having been very hot. The cylinder wall was badly scored, and between the wall and piston were wedged several pieces of broken piston rings. It was also noted that the valve disk was missing from the head of this same block.

According to a report of the affair published in the Hartford *Locomotive*, the following probable sequence of events resulted in the destruction of the compressor: The missing air valve was the first part to let go. When this discharge valve failed, it allowed the compressed air to pass back into the cylinder so that the same air was compressed over and over with each successive stroke of the piston. Continuous pumping of the same air rapidly raised the temperature of the air to such an extent that the piston and rings expanded beyond operating limits. Eventually, the rings buckled against the inside of the cylinder and broke.

Bits of metal from the rings became wedged between the expanded piston and the cylinder wall, causing the piston to seize. This bent the connecting rod and started breaking up the crankcase. After this, things happened rather rapidly and with such finality that total salvage from the compressor amounted to three air filters.

Leaking discharge valves can result in dangerously high cylinder temperatures and should not be tolerated. Even if the compressor does not destroy itself by piston seizure, there is an excellent chance that hydrocarbon vapors from gummy deposits in the discharge line and receiver will explode.

A leaking valve can usually be found by the sense of touch. It is better, however, to inspect and overhaul the valves on a yearly basis.

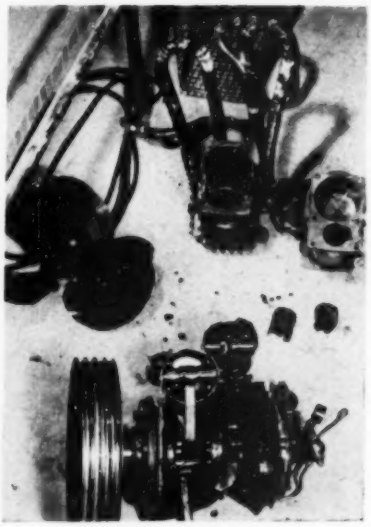


Fig. 2. These pieces were picked up after the accident. Three air filters were total salvage

---

Cases in Smoke Abatement

Bad Tuyeres Cause Smoke, Stifle Fire

By CHARLES W. GRUBER*

FOR THE PAST SEVERAL years the Cincinnati Board of Education has had a modernization program. Each year the heating plants in four or five schools are equipped with new boilers and stokers. The units are fairly standard, utilizing 100-hp boilers, with 600 lb per hr stokers. In 1949 a different manufacturer's stoker equipment was selected on the basis of their low bid.

When the units were fired up in the fall, smoke trouble immediately developed. As usually happens when smoke occurs, other serious difficulties showed up. In this case the stokers would not carry the load.

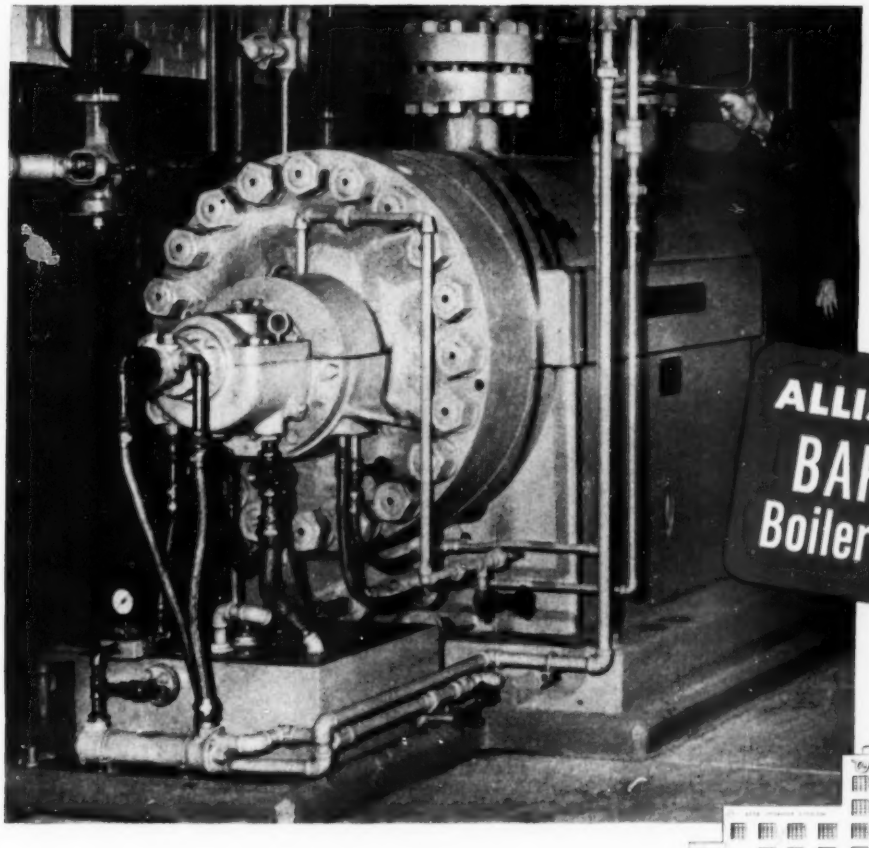
Inspection revealed a black center in the fire — in other words, the fire was burning on the dump grates, with no fire whatsoever in the center of the furnace, and the coal piling up in the center. Although it was obvious that improper air distribution due to bad tuyere design was the cause of the trouble, this was not admitted by the stoker man until he and the coal man had gone through the usual "buck passing". The tuyeres were altered at the suggestion of the BSI to get air penetration to the center of the fire. The smoke cleared up and the load was easily carried. The units have caused no trouble since.

Several months later, this same stoker manufacturer put a set of tuyeres similar to the school jobs on the small commercial stoker of another make. The same smoke trouble and the same conditions developed on this job, though previously it had operated successfully for a number of years. In spite of the recent difficulty on the seven school-house stokers, the coal was blamed again. After several long distance telephone calls, and two hours of discussion on the job, the air distribution was altered and the operation difficulties disappeared.

The lesson is obvious: Proper tuyere design for good air distribution through the fuel bed is essential.

Though the stoker and boiler both were adequate, poor air distribution through the badly designed tuyere section stifled the fire and caused smoke. Opening up air passages (arrows) solved problems

*Chief Smoke Inspector, City of Cincinnati.



One of three barrel-type boiler feed pumps at the Lake Catherine station of Arkansas Power and Light Company. Rated at 525,000 lb/hr, 1800 psig discharge, 3575 rpm, water temperature 350 F. Station engineered by Ebasco Services, Inc.

ALLIS-CHALMERS
BARREL-TYPE
Boiler Feed Pumps

Chosen by Arkansas Power and Light because performance is service proved

Low maintenance, high efficiency

Low maintenance, high efficiency performance records in power plants in all parts of the country . . . that's what led Arkansas Power and Light Company to choose Allis-Chalmers barrel-type boiler feed pumps for their newest outdoor-type station.

Proved design features

Back of that performance record stand many proved design features. For instance, first stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads. Impellers mounted back-to-back balance axial forces without balancing drum. Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

Complete unit from one source

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 08B7899.

A-4286

ALLIS-CHALMERS

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HAGAN

Automatic Control Systems

The many advances in the design of components and the arrangements of Hagan Automatic Control Systems are the result of thirty-five years of experience with all types of control problems.

The accuracy, dependability and versatility of each unit permit Hagan engineers to select the right combination of equipment for coordinated accomplishment of every function required of a system.

The following are just a few of the services for which successful applications have been made.

Automatic combustion control for boilers of any size or pressure, firing all types of fuels, singly or in multiple.

Boiler drum water level control, with automatic compensation available for boiler load or water density.

Draft or pressure control over a continuous range from fractions of an inch water column to 5000 psig.

Superheated steam temperature control.

Steam pressure and temperature control for all types of reducing and desuperheating stations.

Controls for air preheated temperatures.

Feedwater heater pressure or temperature controls.

Controls for parallel or sequential operation of fans, blowers or pumps.

HAGAN
HALL
BUROMIN
CALGON

HAGAN

Ring Balance Instruments

When you buy Hagan Ring Balance Instruments, you choose the most versatile units available for the service involved. The following are some of the factors which make this a reality:

Interchangeable sensing elements for full scale differentials from 1" to 560" WC.

Full scale range of each element adjustable over 7 to 1 ratio.

Dead weight calibration check can be made without disconnecting the meter from the line.

Spring resistance system produces reliability at lower flow ranges.

Mercury level is not critical.

No stuffing boxes or pressure-tight bearings.

Ample operating power at all rates of flow.

The breadth of application of Hagan Ring Balance Meters is indicated by these successful installation types.

Recording, indicating and integrating flows of water and steam, or liquid and gaseous fuels.

Simultaneous records of two separate flows, measured in a single meter housing. Flows may be added or subtracted for accounting and distribution purposes.

Pressure and temperature compensated records of steam and gas flows.

Pneumatic or electric signal transmission available.

Density compensated recording of boiler drum water level.

Density compensated recording of gas or liquid flows.

Flow ratio control for liquids and gases.

Remote recording, indicating and integrating.

Our engineers will be glad to suggest the Automatic Control and Instrumentation best suited to your requirements.

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities

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BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Heat Exchangers with copper and copper-base alloy tubes are widely used for low temperature operation—Courtesy American Locomotive Company, Schenectady, New York.

Low Temperatures Improve Copper-Base Alloy Tubes...

Widely Used in Low-Temperature Processes

The impact strength of many materials becomes seriously impaired at low temperatures and may lead to failure if the equipment is subjected to a sudden shock or blow. Consequently, the selection of the proper metal for the construction of low-temperature service equipment, the heat exchanger tube alloys and the piping are essential.

Also important are the composition of the metal, the effect of heat treatment and the method of fabrication into the finished article. Alloys in solid solution are more stable than those whose structure is characteristic of precipitation hardening. Fortunately corrosion may often be a negligible factor in low-temperature operation.

Low Temperatures Widely Used

Low-temperature applications with Copper, Red Brass, and other copper-base heat exchanger tubes have spread to virtually all industries:

Fractionation of liquid air in the production of oxygen, nitrogen, argon, etc.

Production of low temperatures by liquid nitrogen, hydrogen freon and other refrigerants.

Processing of synthetic rubber, pharmaceuticals and other products.

Refrigeration—marine, industrial and domestic uses.

Separation of waxes from oils.

Solvents—phenol, furfural, chlorinated compounds often used in oil refining and other processes at subzero temperatures down to −150°F.

Carbon Steels Become Brittle at Low Temperatures

The brittle behavior of a given metal can be evaluated by the notched-bar impact test. It cannot be recognized by standard tensile tests or even bending tests. Referring to the accompanying table, at low temperatures most carbon steels show a sudden loss in toughness, becoming brittle or vulnerable to failure from shock, although they gain appreciably in tensile and yield strengths in the low temperature range.

The Izod Impact value of low carbon steels dropped from 94 at room temperature to a low of 3 at −180°C, while per cent contraction of area dropped from 71.8% to 32.5%.

Stainless and low alloy steels with nickel content resist embrittlement at low temperatures and are suitable for structural purposes.

Copper and Its Alloys Improved at Low Temperature

Low temperatures have no embrittling effect on copper and copper-base alloys. In fact, their excellent mechanical properties are considerably improved at subnormal temperatures (as low as −300°F) as compared with room temperatures. For example, the tensile strength of copper rises from 31,400 to 50,800; its elongation from 48% to 57.6%; its Izod Impact values from 43 to 50. Note that the increase in the tensile strength is accompanied with increased toughness.

Brass and Cupro Nickel also show physical improvements at low temperatures. Welded joints made with silicon bronze also have increased toughness at low temperatures. Exceptions are the age-hardened copper-beryllium alloys and the cast Cu-Zn-Pb-Sn alloys.

This explains the wide use of copper and its alloys for low-temperature applications in tubing, piping, valves and in the construction of vessels for handling liquid oxygen. It must not be forgotten that among the advantages of copper and its alloys are their fine heat-transfer properties.

Much technical information on condenser and heat exchanger tube alloys, their applications and physical properties is published in Bridgeport's 156-page "Condenser and Heat Exchanger Tube Handbook." Write for your copy on company stationery. Contact your nearest Bridgeport sales office for your tube requirements and technical service from our Laboratory. (1542)

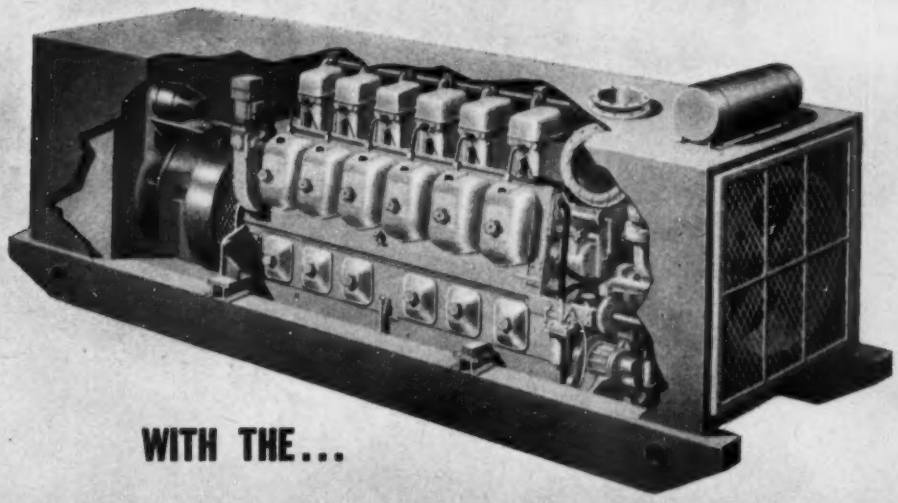
Properties of Annealed Metals at Room Temperature and at -180°C

METAL OR ALLOY	Tensile Strength psi		Yield Strength, 0.1% Extension psi		% Elongation in 2"		% Contraction of Area		Izod Impact Value (ft.-lbs.)	
	at room Temp.	at -180°C	at room Temp.	at -180°C	at room Temp.	at -180°C	at room Temp.	at -180°C	at room Temp.	at -180°C
Copper	31,400	56,800	8,500	11,500	48.	57.6	76.5	77.	43.	50.
70-30 Brass	51,100	73,500	28,200	29,600	49.4	74.6	77.	73.	65.5	78.5
80-20 Cupro Nickel	51,600	73,800	27,700	32,500	25.5	35.6	77.5	72.	77.	85.
7% Aluminum Br'ze	77,300	96,100	26,600	29,200	26.	28.5	29.	30.	24.	20.5
Pure Aluminum	9,800	20,800	4,400	4,550	35.9	43.8	90.4	87.	19.	27.
Low Carbon Steels	65,700	121,500	54,600	60,500	29.7	27.0	71.8	32.5	94.	3.0

For more data circle 546 on Post Card

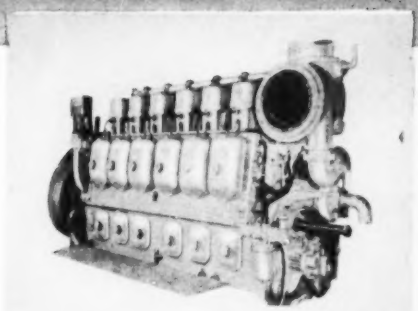
DEPENDABLE POWER

WHERE YOU WANT IT, WHEN YOU WANT IT



WITH THE...

NEW, PORTABLE ALCO DIESEL ELECTRIC GENERATOR UNIT



Alco 6-cylinder, 9" x 10½" (251-A), 4-cycle, turbocharged diesel engine, dry weight 21,350 lbs. Twelve- and 16-cylinder engines also available.

for

- ★ Emergency power generation
- ★ Power during construction or repair
- ★ Supplemental power during peak periods
- ★ Hospital or civil defense standby service
- ★ Scores of other municipal and industrial uses

Here's the answer to your demand for a compact, economical power generating unit for emergency, temporary or standby service.

A completely self-sufficient power plant, the new, portable Alco Diesel Electric Generator unit consists of a 9" x 10½", 4-cycle turbocharged Alco diesel engine, in sizes ranging from 390 to 1300 kw, with all necessary auxiliary equipment.

It can be rail-mounted for electric power *where* you want it, *when* you want it. It can be installed permanently for applications such as standby service in hospitals and municipal power plants.

Either way, it puts dependable power at your immediate call twenty-four hours a day.

ALCO DIESELS

AMERICAN LOCOMOTIVE COMPANY

SCHENECTADY, N. Y.

AMERICAN LOCOMOTIVE COMPANY
P. O. Box 1065
Schenectady 5, N. Y.

Gentlemen:

Please send me complete information about the new Alco Portable Diesel Electric Generator Unit.

Name_____ Title_____

Company_____

Street_____

City_____ Zone____ State_____

For more data circle 547 on Post Card

A house for tomorrow

When Bill Miller first talked to the architect about his new home he stressed his desire to put into it the soundest materials and the newest conveniences.

"I hope my grandchildren will be happy in this house," he explained. "New improvements come fast these days, so let's try to be a few years ahead in our planning."

"What fuel would you like to use?" asked the architect when the discussion reached the heating plant.

"I would prefer to use coal," answered Bill, "I understand it is the most economical fuel here, as it is in most areas. But I don't want my wife to be a furnace-tender."

"With a modern, bin-feed stoker with thermostatic control," said the architect, "your heating will be completely automatic, as well as clean and convenient. And coal has some big advantages – it gives a steady heat, not an off-again-on-again heat. Then there's this for the fellow who looks ahead: I don't know how long these other fuels are going to last. Every year they have to drill their wells deeper, and we are becoming more and more dependent on foreign supplies. As these other fuels get scarcer, they are going to get even more expensive.

"But coal is another story. There is plenty of coal right here in the United States to last us for hundreds—maybe thousands of years. That's something to think about when you're planning a house with the hope that your grandchildren will still be living in it."

COAL
FUEL OF THE FUTURE

Chesapeake and Ohio Railway

Bring your fuel problems to C&O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

Write to:
Coal Traffic Department
Chesapeake and Ohio Railway
2116 Terminal Tower
Cleveland 1, Ohio

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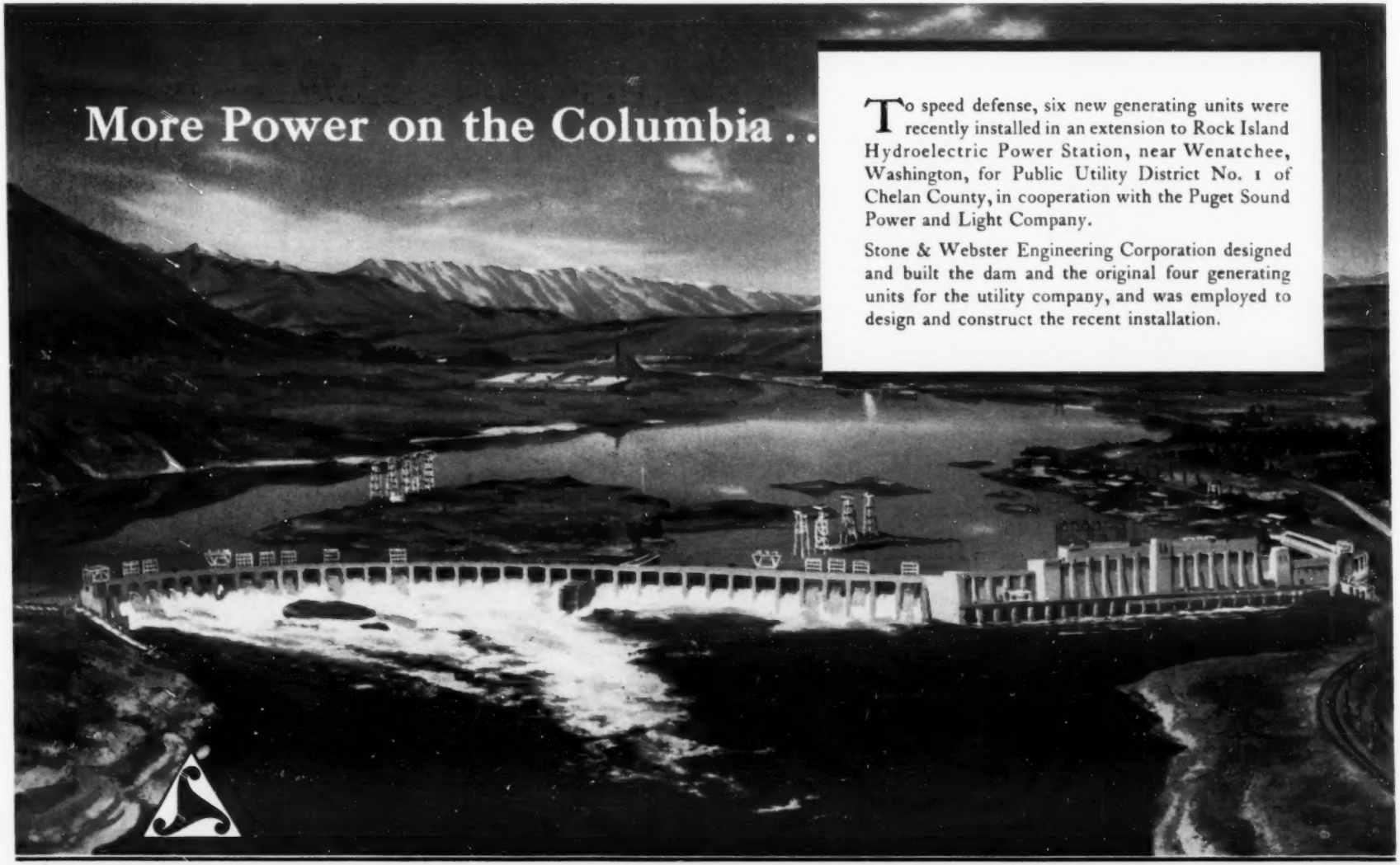
More Power on the Columbia . .



To speed defense, six new generating units were recently installed in an extension to Rock Island Hydroelectric Power Station, near Wenatchee, Washington, for Public Utility District No. 1 of Chelan County, in cooperation with the Puget Sound Power and Light Company.

Stone & Webster Engineering Corporation designed and built the dam and the original four generating units for the utility company, and was employed to design and construct the recent installation.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Toronto

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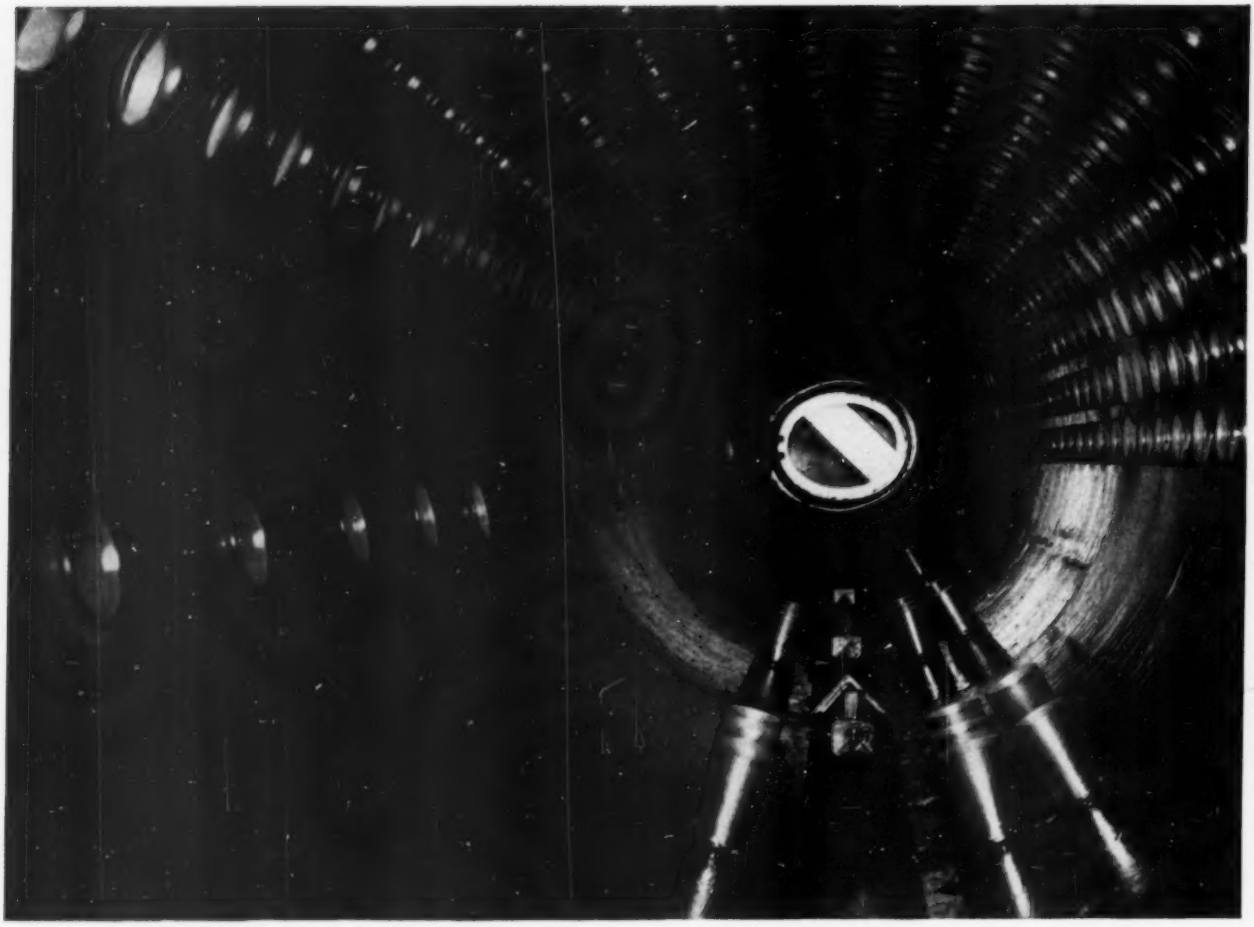


Clean as a whistle

AFTER ONE YEAR OF DEARBORN 659

This boiler used to be cleaned once a year... an expensive, time-consuming job. That was before a Dearborn engineer recommended using 659* sludge conditioner. The picture shows the results. The boiler, upon inspection after a year of this treatment, is clean as a whistle... yearly cleaning has been eliminated.

Dearborn's formula 659 conditions sludge to fluid form, preventing adherence to internal surfaces. Treated sludge is then readily removed by blowdown. In addition, Formula 659 contains Dearborn's patented polyamide anti-foam agents for improving steam quality. Result: higher steam purity, prevention of corrosion in feed lines, closed heaters, economizers and boilers.

BULLETIN NO. 5008 GIVES THE COMPLETE STORY

DON'T OVERLOOK RETURN LINES. Filmeen** prevents return line corrosion, reduces shutdown time and loss of valuable condensate. Safe to use where steam directly contacts food or is used in sterilization. *ASK FOR BULLETIN NO. 5013-A*

*Pat. No. Re-23085 **Pat. No. Re-23614

Dearborn
TRADE MARK

COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

Dearborn

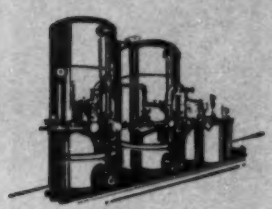
SINGLE WATER TREATMENT SOURCE FOR THOSE WHO TAKE PRIDE IN THEIR PLANT OPERATION

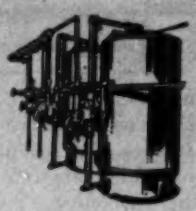
Dearborn provides complete water conditioning and engineering service in one customized program tailored to meet your exact requirements. Dearborn service gives you:

1. Initial plant survey.
2. Recommendations for internal and external treatment.
3. Feeding and proportioning equipment.
4. Water analysis and supervisory service.

Whether your program calls for a system that is manual, semi-automatic or automatic, Dearborn has all the facilities to maintain top boiler efficiency with economical operation. Look to Dearborn ...the *single source* for your water conditioning program.

DEARBORN EXTERNAL TREATMENT SYSTEMS





Dearborn has the knowledge and experience to design and furnish complete ion-exchange equipment, including mono-bed or 2-bed demineralizers, sodium hydrogen split stream units, sodium exchange softeners, designed for use either alone or in conjunction with hot lime softeners.

INTERNAL TREATMENT EQUIPMENT

Get plus results with Dearborn engineered feeding, proportioning and test equipment. Let your Dearborn engineer analyze existing equipment, plan a plant layout, and recommend a system designed to fill your needs—either manual or automatic.

ASK FOR BULLETIN NO. 5000.

KNOW YOUR DEARBORN ENGINEER

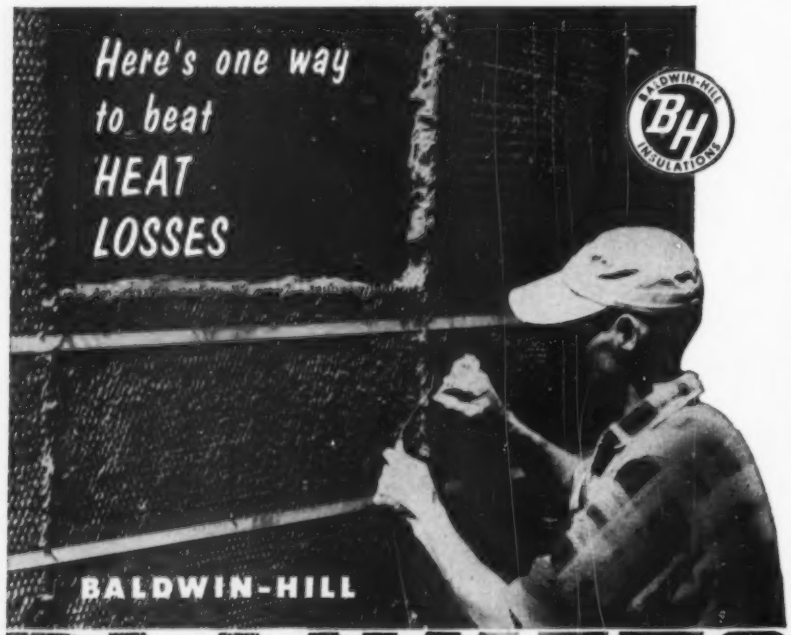
Dearborn has specialized in the conditioning of water and the control of corrosion since 1887. This broad experience in water treatment and rust prevention—plus Dearborn's extensive research and laboratory facilities—is at your service. It will pay you to consult your Dearborn engineer.

ASK ABOUT DEARBORN'S SERVICE AGREEMENT

When your Dearborn engineer calls, ask him to explain the advantages of: a) scheduled on-the-spot tests, b) consultation with plant operation personnel, c) special laboratory tests and reports, d) newest water conditioning methods.

For more data circle 550 on Post Card

You find the solution to many problems in *Power Engineering*



BLANKETS

When you lose heat, you lose operating efficiency and, what's more, those escaping Btu waste your money. Investigate the savings you can make with B-H rockwool BLANKETS. Effective up to 1200° F., they provide exceptional insulating efficiency. High temperature-resisting B-H rockwool is felted in large sheets between various types of metal fabrics to form blankets which are easily applied to large equipment. The soft fiber edges of one blanket merge with the edges of adjoining blankets to form an unbroken layer of insulation. Step up operating efficiency . . . save fuel . . . insulate with B-H BLANKETS. For the correct type and method of application best suited to your job, call on B-H Engineered Insulation Service.

Baldwin-Hill

Clip on signed letterhead and mail

TEAR OUT

BALDWIN-HILL COMPANY, 204 Breunig Ave., Trenton 2, N. J.

Please send complete information on

- ☐ BLANKETS . . . Metal-reinforced, flexible, felted, rockwool insulation
- ☐ NO. 1 INSULATING CEMENT . . . All-purpose, rust-inhibiting, plastic cement
- ☐ MONO-BLOCK . . . Rigid, felted, rockwool block—for high and low temperature use
- ☐ POWERHOUSE CEMENT . . . High adhesion, rockwool, insulating-finishing cement

For more data circle 551 on Post Card

Kearny Nos. 7 & 8

continued from page 68

chromium-nickel-titanium stabilized steel. Tubes carrying reheated steam outside furnace to principal header are chromium-molybdenum steel.

Original station facilities were adequate to supply unloading and storage of coal for the new station. Coal is conveyed from existing station bunkers to eight 50-ton silos, one for each pulverizer. Each silo holds a 4-hour supply at full-load operation. Conveyer belts deliver the coal from the bunkers to small hoppers serving Redler conveyers, which are arranged to keep the silos full automatically. The coal for each boiler is weighed on the conveyer belts feeding the hoppers of the Redler conveyers.

Ash and dust systems are separate. The dust system is arranged so that it can be refired in the furnaces or sluiced by jetting to the disposal area. The ash system includes facilities for jetting the slag to the disposal area or to a dewatering bin for sale.

Each electric generator is rated at 161,765 kva, 0.85 pf, 30 psi hydrogen cooling pressure, 3600 rpm, 20,000 v. Control of the two units is separate from the old station. Both main units have direct-coupled auxiliary generators, Fig. 3, to furnish power for station auxiliaries. Each auxiliary generator is rated at 12,000 kva, 0.80 pf, 3600 rpm, 4160 v and is air cooled. Rotating amplifier-type voltage regulators are used on main generators.

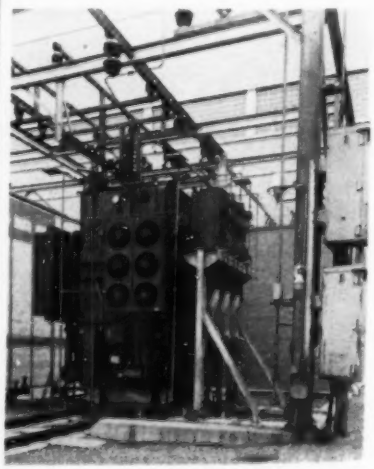


Fig. 7. One of the forced-oil, forced-air cooled 100,000-kva main transformers for the new units

Suitable protective devices and relays are installed for ground faults, phase-to-phase faults, out-of-step protection and loss of excitation. The generator lead from each generator is run as a 5000-amp, 23 kv metal-enclosed isolated bus having, as component parts, withdrawal-type surge-protection arresters and capacitors, potential transformers and a main generator gang-operated disconnecting switch, Fig. 8. *cont. on page 108*

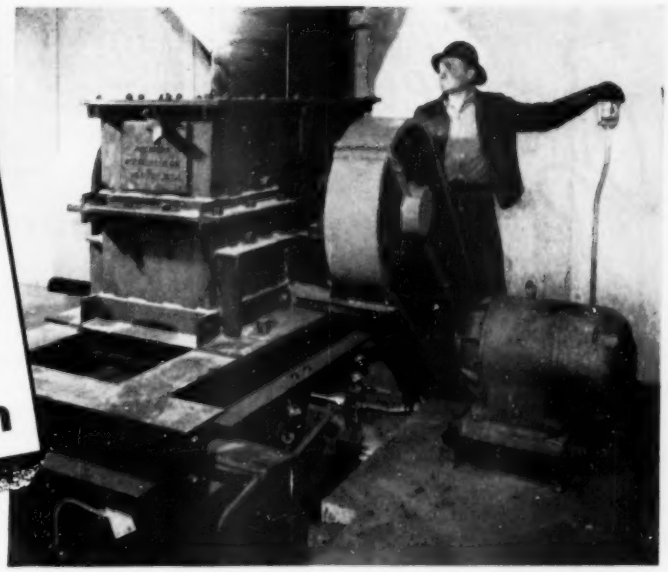
Actual Figures... *NOT Claims*

Prove that AMERICAN "WC" coal crushers are top performers at low operating costs!

CRUSHING FACTS
based on User-Reports from
12 Power Plants & Coal Mines

Total Tonnage Crushed:
1,507,827 tons

Parts Replacement Cost:
$0.0028 per ton



When the actual tonnage figures (as supplied by the Chief Engineers of power plants and the Preparation Engineers of coal mines) are compared with the total cost of replacement parts ordered, the real story of the quality and efficiency of American "WC" Coal Crushers is apparent—the story given in the panel above.

With American, quality is not a mere claim, nor even an isolated performance story. It is based on the consistent pattern of high-tonnage-at-low-maintenance for *all types* of American coal crushers—a record directly traceable to the efficient crushing action of the American-originated rolling-ring crushing principle, plus a half century of specialized experience in building coal crushers.

American "WC's" are designed for capacities up to 90 tons per hour . . . but whether your requirements range from coal sampling up to 600 tons or more per hour, American has the crusher to handle your job at the lowest possible cost.

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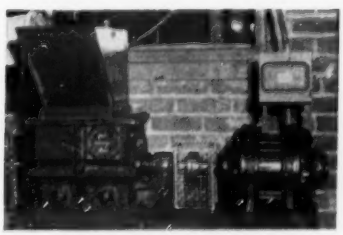
Model 9-9 American Laboratory Crusher, one of several sizes for reducing coal samples prior to analysis.



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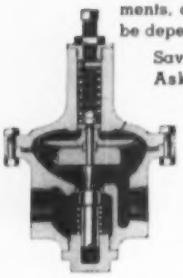
for efficient operation

Clark Pressure Reducing and Regulating Valves

are precision-made for positive pressure control on air, gas or steam lines.

Where different types of equipment, with varying pressure requirements, are operated from a common line, Clark Regulating Valves can be depended on to deliver automatically the "just right" pressure to each.

Save on fuel, maintenance and protect expensive equipment. Ask your Clark representative to specify the right Clark valves for your needs . . . or write us direct.

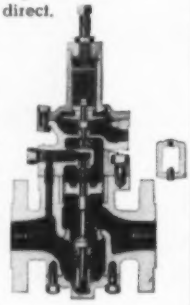


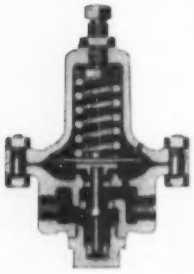
TYPE KRV

Pressure Reducing Valve. Diaphragm Operated-Single Seated Valve. Sizes ½" to 1½" for initial pressures up to 250 P.S.I. Reduced pressures to 85 P.S.I.

TYPE CRV

Pressure Reducing Valve. Integral pilot controlled, piston operated. For pressure control from "dead end" to full capacity. Sizes ½" to 6".





TYPE ORV

Pressure Reducing Valve. ⅜" and ½" Single Seated, Spring Loaded, Diaphragm Actuated. For initial pressures to 250 P.S.I. Reduced pressures to 200 P.S.I.

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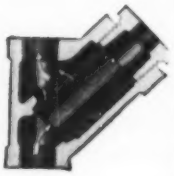
Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S. For pressures to 250 P.S.I.



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The transformers, one shown in Fig. 7, are 3-phase units, rated 100,000 kva, forced oil, forced air, first of this type on the Public Service system.

All auxiliary power equipment is electrically driven from two sources, the auxiliary generator and a 9000 kva auxiliary power transformer, the latter used as an emergency source and for starting.

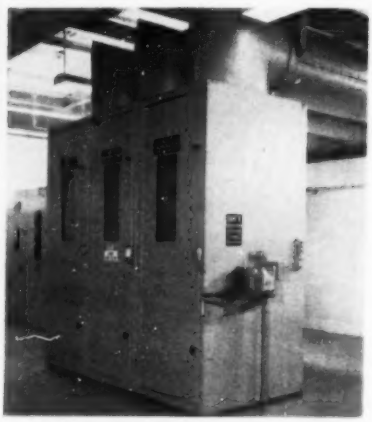


Fig. 8. The main leads of No. 7 generator, shown at the isolated phase bus disconnect compartments

Excitation for both main and auxiliary generators is provided by a 3-unit motor generator set equipped with a flywheel.

Low-voltage supply of each unit is provided by load centers including one for a portion of the lighting. Totally-enclosed motors are used in all outdoor locations and in damp or dusty locations inside the station, including drives for FD and ID fans, circulating pumps, boiler feed pumps, and the like. All motors start across the line, including the water-cooled boiler feed pump drives.

The d-c system is an extension of the existing 125/250-v 3-wire system in the old station, which consists of two independent sections each with its own battery and motor-generator set for charging.

The new Kearny station was designed by the Electric Engineering Department of Public Service Electric & Gas Co., and built by United Engineers and Constructors, Inc.

OBITUARIES

T. Barclay Whitson

T. BARCLAY WHITSON, director of engineering and a member of the board for the James G. Biddle Company, manufacturers of electrical testing equipment, died January 23, at his home in Moylan. His age was 59. He was graduated from Westtown School and *cont. on page 110*

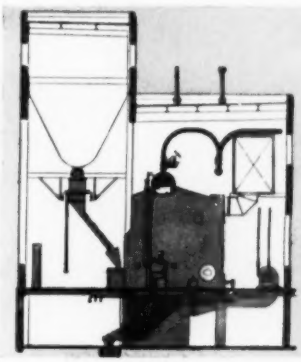
"74.2% MORE STEAM PER DOLLAR—

that's what this modern coal installation gives us at Perfection Stove Co.!"

says George I. Chittenden, consulting engineer for the Perfection Stove Company.

Perfection's old installation, if operating today, would generate 1,362 lbs. of steam per hour per dollar. The new plant produces 2,373 lbs. of steam per hour per dollar. Here's proof of the economy and efficiency of bituminous coal burned with modern equipment.

This view of Perfection Stove's new steam plant shows the coal elevator and ash silo. Coal is delivered through an under-track hopper, lifted by elevator to storage. A pneumatic system carries ashes to the silo.



This sectional drawing of the plant's boiler installation shows the coal bunker over the firing aisle. A weigh larry with dust-proof connection feeds coal to the stokers. The plant is clean and efficient—typical of the modern design that makes full use of coal's inherent advantages.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

● More and more consulting engineers are advising their clients that *bituminous* coal is the best buy for steam fuel. *Here's why:* Nearly everywhere coal yields more BTU's per dollar . . . modern combustion installations step up this inherent economy . . . up-to-date coal- and ash-handling systems cut labor costs to a minimum.

Tremendous reserves give coal a future dependability of supply no other fuel can offer. And to mine this coal, America has the world's most productive and efficient coal industry—making coal the one fuel most likely to remain reasonably stable in price.

If you're building or planning to modernize a steam plant, call in a competent consulting engineer. He'll show you how a modern coal installation can save you money and do a more efficient job, too!

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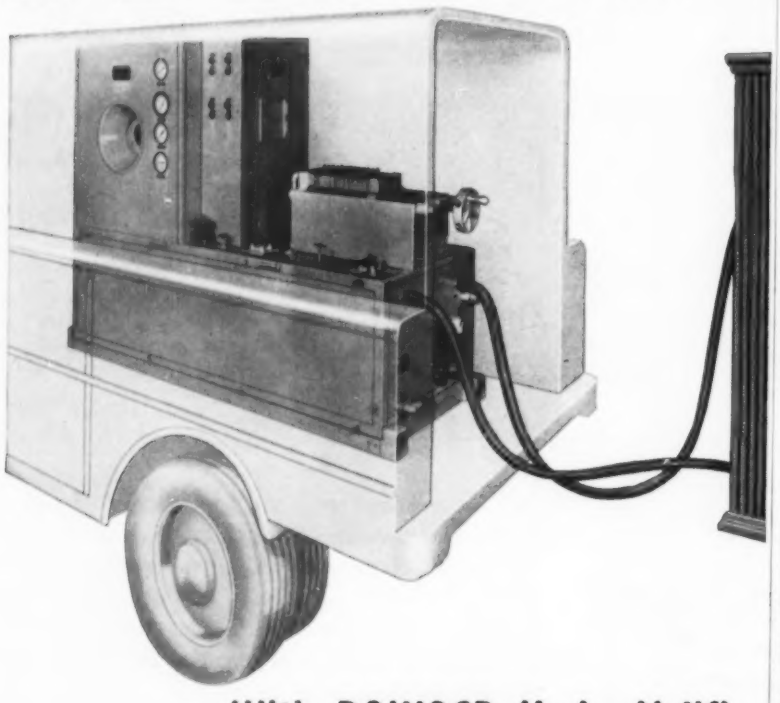

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In a single pass the Bowser Hydro-Volifier restores oil dielectric to 35 k.v.!

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Obituaries

continued from page 108

Haverford College. He served in France with the American Friends Service Committee at the close of World War I. He joined the James G. Biddle Co. in 1922 after having worked at the Exide Battery Co. and the Rubicon Company.

T. Barclay Whitson

He was clerk of the representative meeting of the Arch Street Yearly Meeting of Friends and a member of the American Institute of Electrical Engineers, Franklin Institute, the Mineralogical Society of Pennsylvania and the Engineers Club of Philadelphia.

De-Oiling Water

continued from page 87

a clear water virtually free from oil (without filtration).

2. The additional benefit of 10 ppm of chlorine.

3. The advantage of alum floc over copperas floc for producing best settling.

4. The need for optimum coagulation pH for producing best results.

Subsequent and present operation of this plant has proven the effectiveness of 1000–2000 ppm of alum floc sludge in contact with the water in reducing over-all chemical dosages (including expensive chlorine) and in producing the clearest effluent quality. The sludge contact principle, making use of sludge recirculation and upward sludge blanket filtration, are both effective in this regard. This is particularly true with 15–20 minutes total time of contact within the equipment.

Oil in boiler feedwater usually originates from these three sources.

1. Condensed steam or exhaust carrying oil compounds from reciprocating engines, pumps, compressors, etc.

2. Direct leakage into steam used in process heat exchangers.

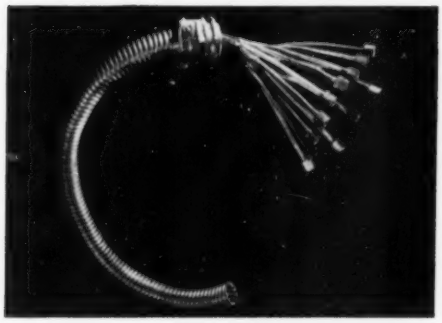
3. Industrial waste water leakage.

It is necessary to remove oil from boiler feedwater because it may cause foaming, *cont. on page 138*

For the new pneumatic instrumentation

Cabled Tube

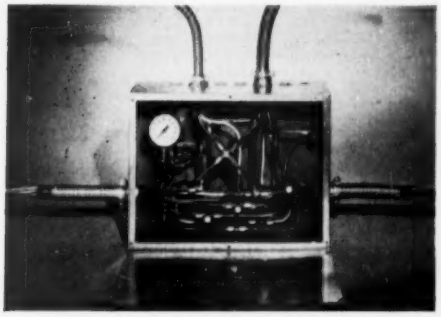
The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube



remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

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Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

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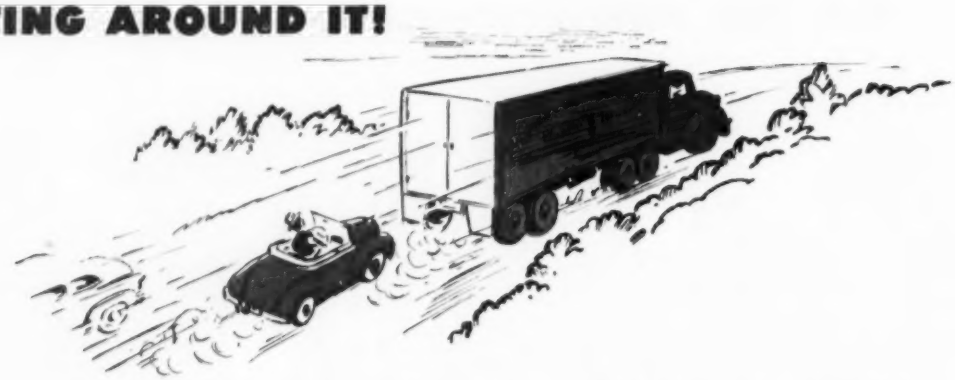
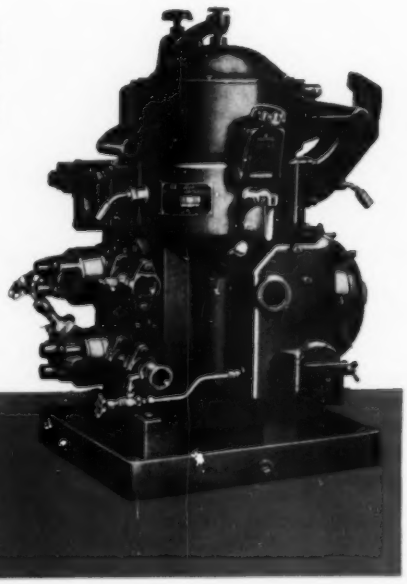


De Laval Turbine Oil Purifiers Prevent Contamination Trouble by Removing the Causes

De Laval Centrifugal Oil Purifiers remove both of the chief causes of lubricating oil deterioration—dirt and water. They are positive insurance that no trouble will occur that can be charged to impure oil.

A De Laval Oil Purifier does a thorough job. Every drop of water is promptly thrown out by centrifugal force and continuously discharged to waste. Dirt is likewise thrown out of the oil and stored outside of the zone where purification takes place.

An important advantage of the De Laval Oil Purifier is the fact that it has enough reserve capacity to take care of a sudden emergency such as a surge of water due to a leak.



THE DE LAVAL SEPARATOR COMPANY
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INSTRUMENTS AND CONTROLS

201 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation" consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation are discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

202 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

203 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

It's easy to get these free catalogs—just circle item numbers of those wanted on the post card at right.

204 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

205 Oxygen Analyzers, Recorders — Bulletin 105, 6 pp, describes and pictures oxygen analyzers and recorders giving their general characteristics, and features, explaining their paramagnetic principle of operation, and discussing their applications. Covers both deflection and null type analyzers; discusses sampling requirements. Arnold O. Beckman, Inc.

206 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, opera-

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16	17	18	131	132	133	134	135	136
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237	238	239	240	241	242	243	244	245	246	247	248
249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280	281	282	283	284
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tional data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

207 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analysers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

208 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

209 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

210 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

211 Pneumatic Valve Operator — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

VALVES, TRAPS, PIPING AND ACCESSORIES

212 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

213 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

214 Solenoid Operated Valve — Eight-pp Technical Bulletin W-7 describes solenoid operated valves which automatically open or close in response to time clock, pressure switch, manual switch or other impulse. Contains operating instructions, illustrated parts lists, and dimensions for these valves, used in steel, processing, pulp and paper mills, rubber and

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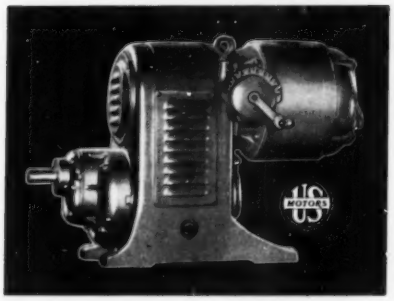

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3 Sure ways to LICK FEEDWATER PROBLEMS

- END SCALE FORMATION
- REDUCE BLOW-DOWN AND MAKE-UP
- CUT DOWN COSTLY BOILER REPAIRS

WITH

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DEMINERALIZED WATER

Thousands of Power Engineers have solved their Feedwater Problems *positively* and *permanently* with Barnstead Demineralized Water.

ONLY a constant supply of high-purity demineralized water can end the expensive nuisance of scale formation ... do away with excessive blow-down and make-up ... keep your boilers trouble-free year after year.

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Only Barnstead engineers can analyze your feedwater requirements in detail, recommend equipment *exactly suited* to your needs and provide a *positive, permanent* solution to your problem.

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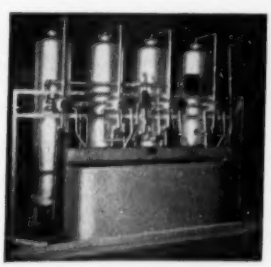

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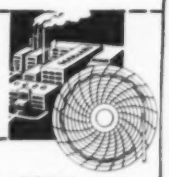
CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.



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Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

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Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

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Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.

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chemical plants, and water works. Golden-Anderson Valve Specialty Co.

215 General Service Valves —Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

216 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

217 Butterfly Valves — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

218 Pump Valves — Sixteen-pp Catalog SC-510, now available to power engineers, describes and illustrates valves made to fit practically all makes of reciprocating pumps. Key features of the valves are discussed, and standard, lock-in and deck types are covered in detail. Sims Pump Valve Co., Inc.

219 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

220 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

221 Pressure Reducing Valve — Bulletin 228, 8 pp, describes and pictures a pilot-operated pressure reducing valve designed for automatic control of reduced pressure required in steam service. Gives advantages of the valve, illustrates method of installation. McAlear Mfg. Co.

222 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

223 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

224 Piping Pointers — This is company's highly popular 36-pp manual cov-

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40% less
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50% more
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Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

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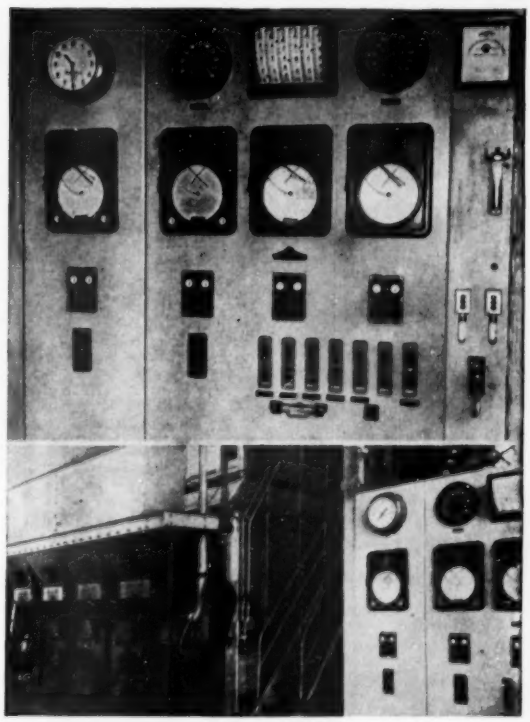

Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

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Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

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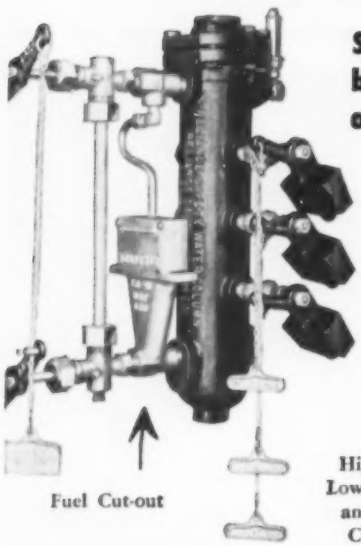
New Reliance Levalarms

. . . simple, safe, sure controls for audible and visible water level alarms and fuel cut-out



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The name that introduced safety water columns . . . . in 1884

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BOILER SAFETY DEVICES

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ering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

225 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

226 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

227 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

228 Data on Strainers — Several types of pipe line strainers for all purposes in sizes from ½ to 36 in. are described and illustrated in 16-pp Manual 951. Summarizing important developments, booklet carries information on factors to consider in selecting a strainer for a specific application. J. A. Zurn Mfg. Co.

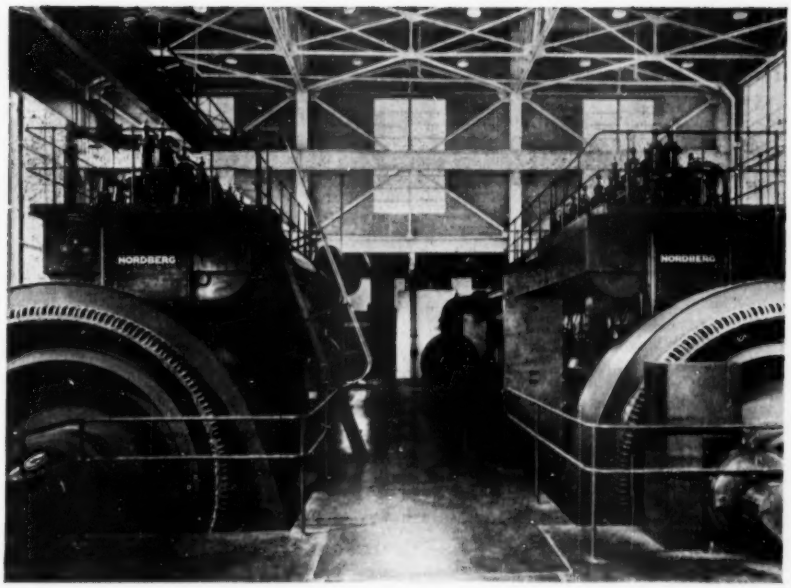
229 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

Postage-free cards for ordering catalogs are on pages 113-114. You may also use the cards to ask for further information on the advertised products

230 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

231 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size con-

W. T. Elliott,
Power Plant Supt.,
says...



"We've Got Facts to Prove Rubilene's Superiority"

A lot of people depend on Mr. W. T. Elliott. For it's his job as Power Plant Supt. to see that the City of Denton, Texas has unfailing light and power 24 hours a day. To help live up to that responsibility, Mr. Elliott pampers his hard working Nordberg Duafuel® engines – makes sure they're lubricated with the finest oil available. He says, "We've been using Sinclair RUBILENE® since 1948 with *very satisfactory results*. Cylinder liner wear is only ⅓ of 0.001 inch per 1,000 hours running. Piston ring life is 16,000 hours of operation and we get 6,100 H.P. hours per gallon of oil... Facts like those have definitely sold me on RUBILENE."

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SINCLAIR DIESEL LUBRICANTS

save wear and replacements

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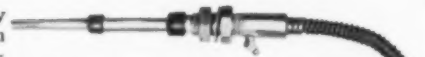
Accuracy . . . High Load Capacity . . . Adaptability . . . Freedom from Trouble . . . Long Life . . . Flexibility . . . these are some of the qualities of **ACCO TRU-LAY PUSH-PULL FLEXIBLE CONTROLS** that have made it possible to improve the operation of literally hundreds of mechanical products (list on request). Full description of this versatile REMOTE CONTROL is given in our **DATA FILE** available for your further study.

ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

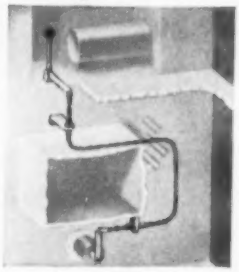
VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . **HOT** jobs on jets and industrial furnaces . . . **COLD** jobs down to —70° F. . . . **WET** jobs (the conduit can be completely immersed) . . . **DIRTY** jobs . . . **ABRASIVE** jobs . . . **CORROSIVE** jobs . . . **HEAVY, TOUGH** jobs up to 1,000 lbs input . . . **LIGHT DUTY** jobs . . . **REMOTE** jobs 150 feet or more from the control point . . . these units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

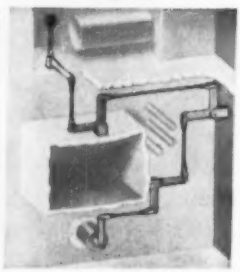


"SOLID as a rod but FLEXIBLE as a wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This *flexibility* provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration—protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions. . .

to give you this simple and effective assembly

. . . rather than this complex (and expensive) series of linkages





ADAPTABILITY to all sorts of mechanical situations explains, in large measure, the wide-spread application of TRU-LAY PUSH-PULLS. Standard anchorages, fittings and heads have been designed that meet requirements on approximately 80% of the installations. Simple modifications of these standards, or minor changes in your own design, cover almost every special situation. Our engineers have the know-how on such matters.

FREEDOM FROM TROUBLE and **LONG LIFE** are assured even under exceptionally adverse operating conditions because of such things as . . . full protection of the flexible, inner, working member by the tough flexible conduit . . . lubrication of the inner, working member *for life* during assembly . . . seals that keep moisture, dust and other foreign matter out of the unit . . . cold swaging of fittings that makes them integral parts of the control unit. (Full construction details in our **DATA FILE**). We have never heard of a TRU-LAY FLEXIBLE PUSH-PULL CONTROL wearing out in normal service.

Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this **DATA FILE** will answer your further questions, and will also provide you with the means of defining to us the application you may be interested in.

DATA FILE

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densate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring

232 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

BOILERS, GENERATORS

233 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions given. The Babcock & Wilcox Co.

234 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

235 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

236 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

237 Scotch Marine Boilers — Bulletin 236 illustrates and describes a Scotch type of boiler on skids suggested for a wide range of applications. This boiler can be hand- or stoker-fired with coal or can use oil, gas or wood as fuel. Gives construction details, stresses versatility, other advantages. Includes test data and specifications. The James Leffel & Co.

238 Steam Boilers — Form AD-100 is an 8-pp catalog providing complete description of company's self-contained boiler, hot water or steam, for heating and processing. Includes design details, capacities, dimensions and application information on boilers ranging from 15 to 500 hp and 15 to 250 psi. Cleaver-Brooks Co.

FUEL OILS, LUBRICANTS

239 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication re-

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Raw Water #628

It's really Mississippi River water. An oil refinery uses it for boiler feed and for process water.

We worked on #628 . . . on the whole problem of this refinery's water requirements.

As it came from the river #628 obviously could not be used. It was so full of dirt it looked like *café au lait*. Treated now through Graver equipment, it is completely safe for delicate, high pressure boilers.

Raw water #628 could have been useless for any of several other reasons: hardness, silica, bicarbonate alkalinity or oxygen content. No matter what the problem, Graver is in business to help you solve it . . . with laboratory and pilot plant testing, equipment design, manufacturing, erection facilities, and anything else it takes to give the water you want.

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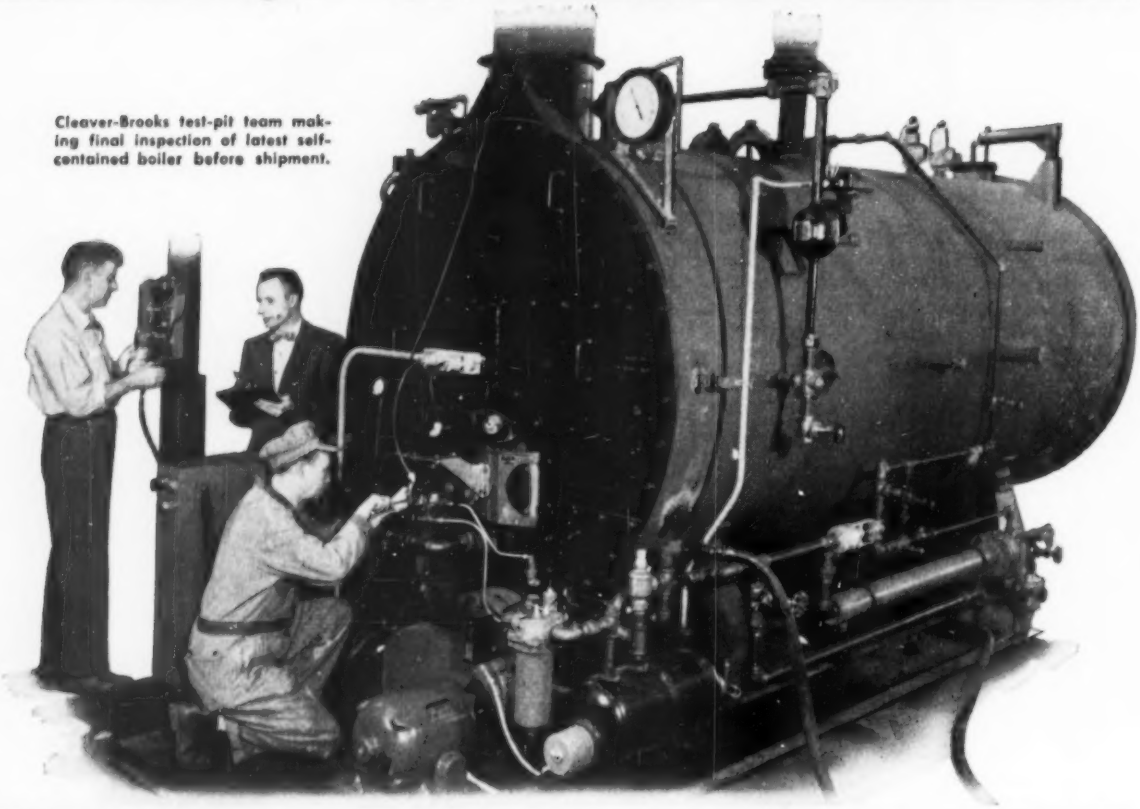
their counterpart "Test-Pilots" have at Cleaver-Brooks

Cleaver-Brooks test-pit team making final inspection of latest self-contained boiler before shipment.



HIGH SCORES . . . on factory and on-job tests guarantee greatest return from boiler investment

When test pilots give the familiar "O.K." — that's the sign of proven performance. It's the same with boilers in the Cleaver-Brooks plant. Only after accurate, thorough inspection and testing under actual operating conditions do boilers get the final "O.K." from experienced test engineers. That's why you get guaranteed 80% efficiency from your Cleaver-Brooks boiler when firing with oil.

A record of this test is available to every buyer on request. In fact, you as a buyer, consultant, or contractor are invited to witness the actual test on your Cleaver-Brooks boiler before shipment.

And further, Cleaver-Brooks boilers are placed in operation at the job site by factory service engineers who check installation, train your operators and make complete and detailed field tests.

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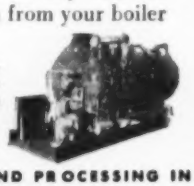

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quirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

240 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

241 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

242 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

243 Compressor Lubrication Problems — Vol. 40, No. 1 of Lubrication provides a 14-pp article on problems associated with compressor lubrication. Reviews compressor types, function of the lubricant and importance of adequate installation. Air compressor explosions and receiver fires are discussed, as are condensation and compressor cooling, bearing lubrication, selection of lubrications. Special problems of air, gas, refrigerator, and other compressors are treated. Includes lists of factors which control dependable compressor operation, and those which may react against efficiency. The Texas Co.

244 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

245 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

246 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

BURNING EQUIPMENT

247 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping

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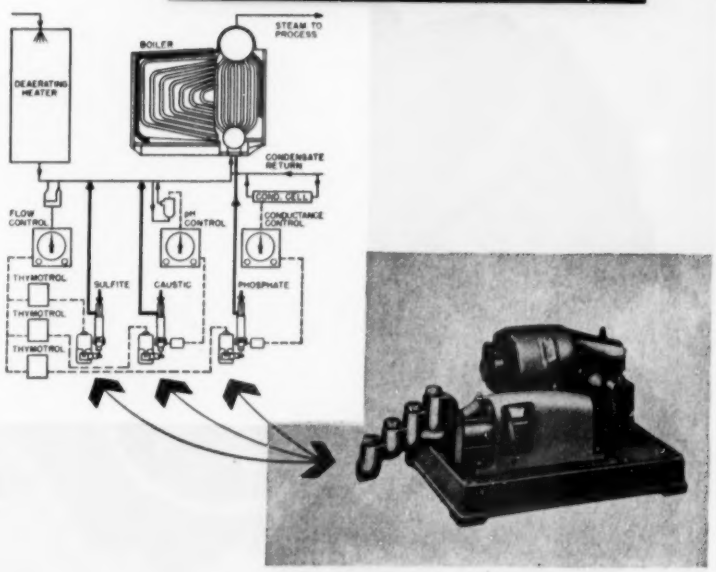

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In the system illustrated, three Milton Roy Controlled Volume Pumps *automatically* control the proportional feed of treating chemicals to boiler feed water: sodium sulphite for oxygen removal . . . di-sodium phosphate for calcium precipitation and scale prevention . . . caustic for pH control. Results? Decreased turbine and boiler downtime . . . optimum boiler water conditions!

Thousands of such Milton Roy complete water treating systems and Controlled Volume Pumps installed throughout industry save time and money for large and small power plants alike. Standard "packaged" systems are furnished complete, for pumping controlled volumes of chemical additives against any boiler pressure.

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This True Ball Joint Makes the Difference

Darts give a snug, drop-tight fit easily — without fussing or excessive wrenching — there's no lost time in installation. Yes, and you can use Darts over and over again on many different installations for real economy!

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diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

248 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

249 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

TUBING AND ACCESSORIES

250 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

251 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are given. Scovill Mfg. Co.

252 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

253 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

254 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

255 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads

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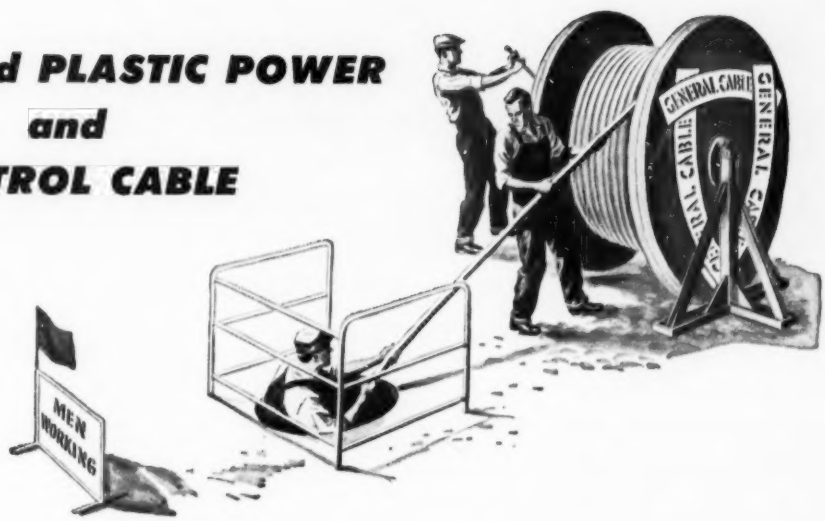

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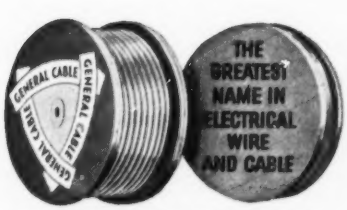

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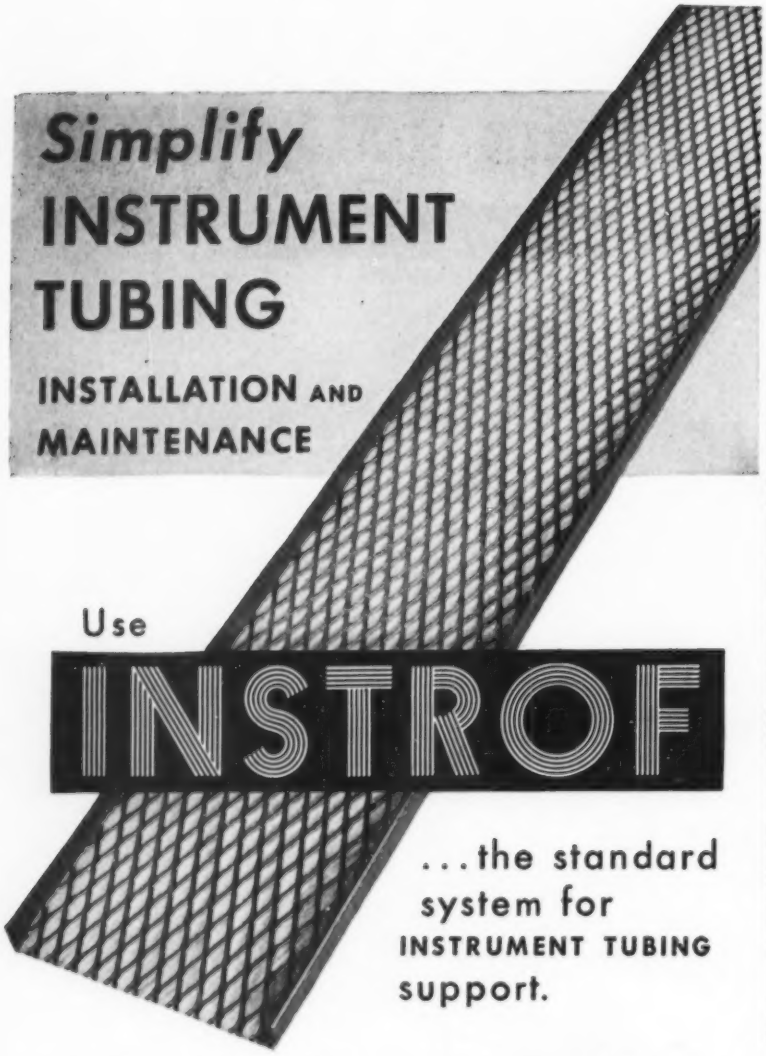

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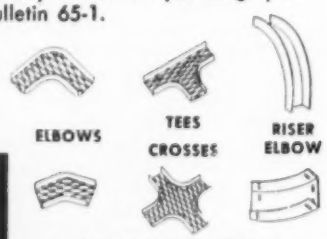

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discussing special features. Roto Div., Elliott Co.

256 **Data on Stress Values** — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

COAL, ASH HANDLING

257 **Spreader Stoker Data** — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates; the third, installations. Riley Stoker Corp.

258 **Spreader Stoker** — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

259 **Spreader Stoker Selection** — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

260 **Economic Coal Storage** — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

Postage-free cards for ordering these catalogs are provided on pages 113–114. When using them, don't forget to include your job title and company name —even if you want your catalogs to be delivered to your home address

261 **Automatic Coal Scale** — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

262 **Ash Handling Systems** — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are also included. Beaumont Birch Co.

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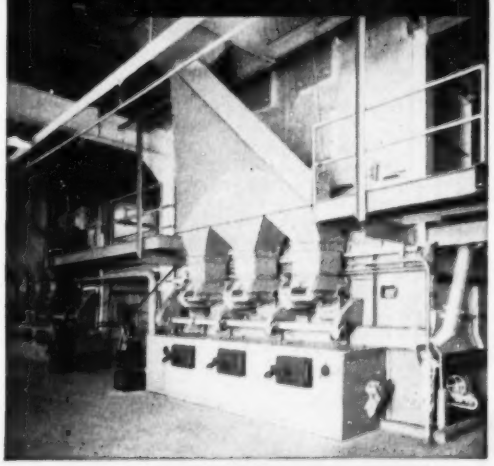

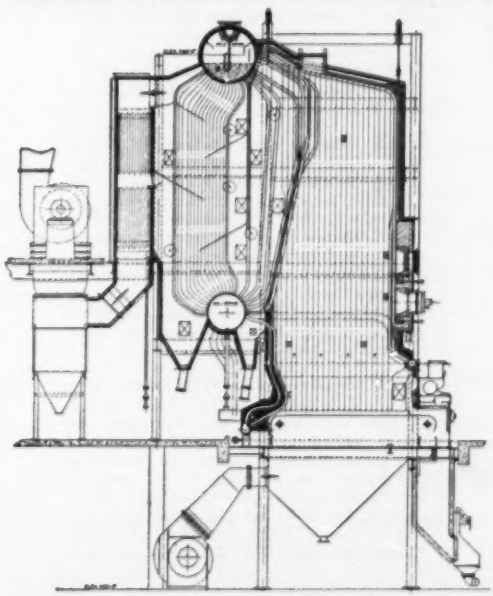

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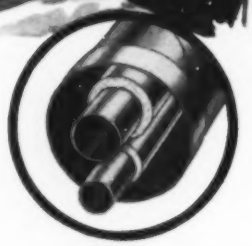

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263 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Also describes CMP units which combine in a single installation the advantages of the Multiclone cyclonic tube with the Cottrell electrostatic precipitator. Western Precipitation Corp.

264 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

WATER CONDITIONING

265 Handbook on Demineralizing — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multistage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

266 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

267 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

268 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater makeup requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

269 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

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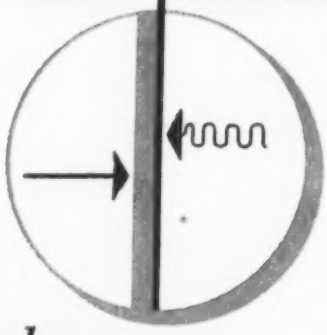

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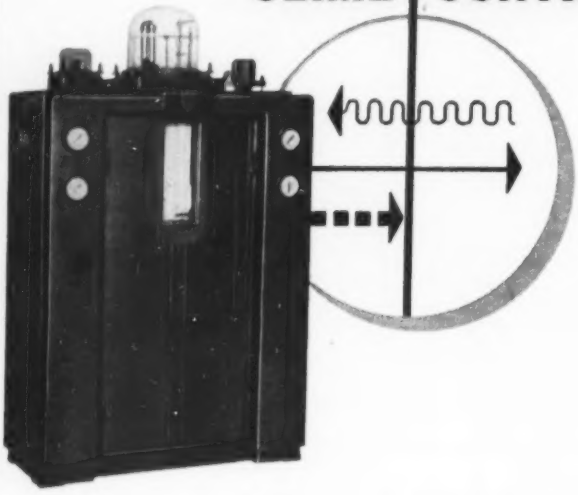

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270 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

271 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

272 Mixed-Bed Demineralization — Bulletin 126 explains in text and pictures how a mixed-bed demineralizer operates in producing high-purity water by ion-exchange method. Stresses company's simplified positive regeneration system which separates resins quickly and remixes them. Barnstead Still & Sterilizer Co.

273 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

274 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

275 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

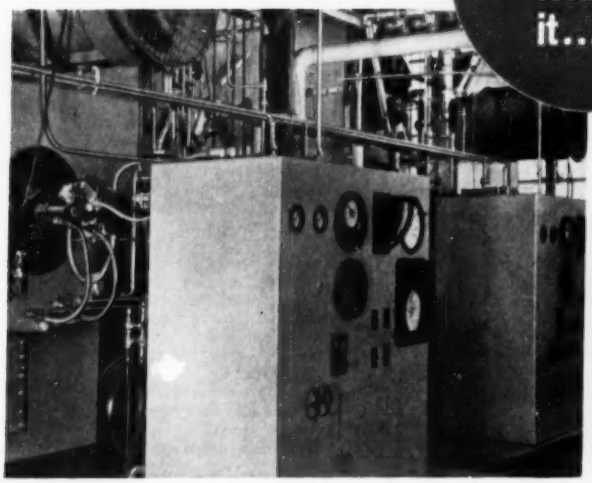
276 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

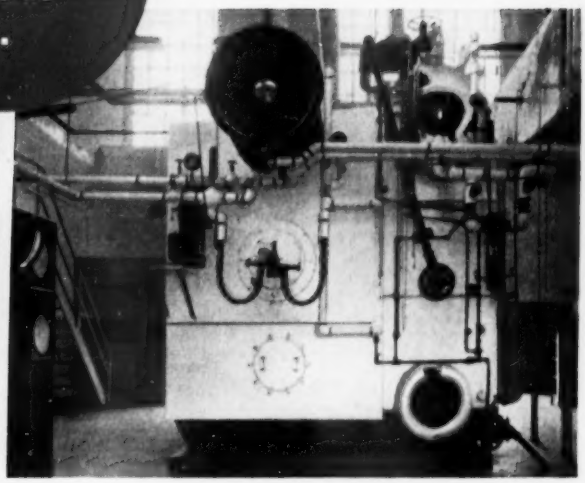
277 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment used in these tests are also presented. Hall Laboratories, Inc.

INSULATION

278 Pipe Insulation — Mono-Kover, a lightweight one-piece pipe insulation, is described in this bulletin. Photos show how easily it is applied, and text covers its thermal resistance, permanence, resiliency, non-corrosive properties and lower applied cost. Also included are a thermal efficiency chart, insulation thickness selection table, and sizes, thicknesses. Baldwin-Hill Co.

any way you look at it...





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G-630

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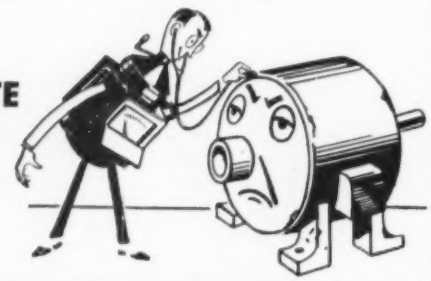

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279 Insulating Material — Ultrafine, a thermal and acoustical insulation made of blown glass fibers, is presented in this bulletin. Shows it in use; gives data on properties, thermal conductivity. Gustin-Bacon Mfg. Co.

PUMPS, PUMPING

280 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature available on each of them. Goulds Pumps, Inc.

281 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

282 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

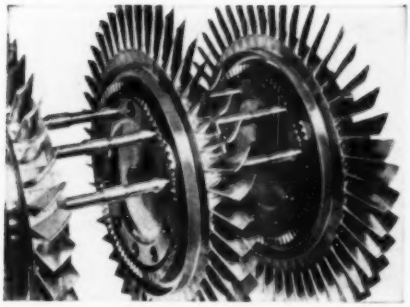
283 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

284 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

ELECTRICAL

285 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

286 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of



The turbine rotor is a set of interlocking discs held together with Inconel "X" bolting. The forged Inconel "X" blades fit into pine-tree grooves machined axially on the discs. The blade contours provide for maximum conversion of heat energy into work; the use of Inconel "X" assures dependable performance under high temperature conditions.

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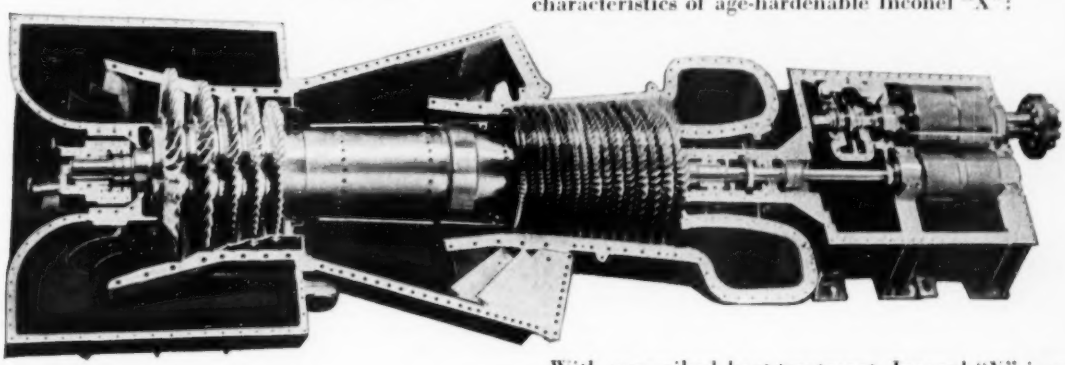
have they a place in your future?

The combustion gas turbine is past the experimental stage. It's a new source of power for mechanical drive applications.

Many problems, of course, had to be worked out before the new turbine got to where it is today. The problem of metal failure at high temperatures, for example, caused trouble time and again.

But now the WESTINGHOUSE ELECTRIC CORPORATION has a practical answer. This major turbine builder is using Inconel "X" for blading and high temperature bolting. Inconel "X" provides the longest periods of uninterrupted service at the lowest cost yet achieved.

If you want to know why, just look at some of the principal characteristics of age-hardenable Inconel "X":



Converts gaseous or liquid fuel directly into mechanical power. This Westinghouse 7000-hp gas turbine plant is of the simple open-cycle type. Its three major components, axial flow air compressor, combustion system and gas turbine, are contained in a single casing assembly. Rotor blades are forged from Inconel "X" bar stock. The bolts holding rotor discs together are also Inconel "X". (See photo above.)

With prescribed heat-treatment, Inconel "X" is one of the most useful alloys available for service at 1350° to 1500°F. It has good creep strength and excellent resistance to oxidation at these high temperatures.

Its stiffness, or modulus of elasticity, is about equal to that of alloy steels. Its resistance to impact is good, too. And it can be forged, fabricated and machined, can be welded by all the commonly used processes.

What's more, Westinghouse engineers have found Inconel "X" a good commercial quality material with little variation from melt to melt. That's because Inconel "X" is a standard alloy which Inco has produced steadily for a number of years.

Whether combustion gas turbine power plants figure in your immediate future or not, you'll do well to remember Inconel "X". It could very likely be the metal best suited to solve a high temperature problem in *your* plant. Don't hesitate to call on Inco's Technical Service Section for any information and help you want. There's no obligation, of course.

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Western Precipitation is unsurpassed in the all-important factor of "know-how" in BOTH the electrical and mechanical fields . . . knows from years of first-hand experience whether your particular problem can best be solved by mechanical or electrical methods—*or by a combination of the two* . . . can give you a direct and unbiased recommendation on the matter . . . and then can provide the complete installation under *one* responsibility, *one* overall performance guarantee, even where Combination Multiclone-Precipitator (CMP) installations are made!

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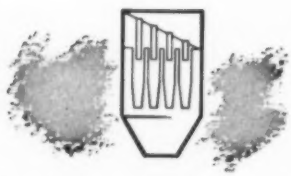

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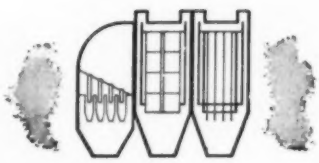

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. . . combine, in *one* compact installation, *both* mechanical and electrical recovery principles so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally removes the larger and heavier suspensions (down to a few microns in diameter) . . . and the COTTRELL section then electrically removes the very small particles remaining in the gases. Thus, the bulk of the recovery is obtained with relatively low-cost equipment, and the final clean-up is obtained with equipment having unusually high recovery efficiency—approaching theoretically perfect, if desired.

The recovery of suspensions from gases is a highly exact science and every problem is different. Some require mechanical methods—others electrical methods—still others a combination of mechanical and electrical methods in proper balance to meet the individual requirements of each application. No matter what your problem, remember that only Western Precipitation has had years of field experience in BOTH mechanical and electrical methods!

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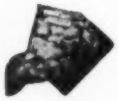

Let our experienced engineers study your recovery requirements and make an unbiased recommendation on the equipment best suited to your particular problem. A wire, phone call or letter to our nearest office places this unique "know-how" at your service, without obligation.

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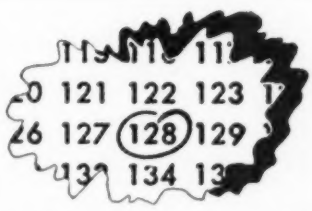
power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

287 Motor Lubrication — Three methods of lubricating electric motors — cartridge, standard open and company's Lubriflush — are compared in 8-pp Bulletin 1848. To demonstrate action of relubrication in Lubriflush bearings, a series of natural color photos of a transparent bearing housing is reproduced. Necessity of annual lubrication is demonstrated photographically. U. S. Electrical Motors Inc.

288 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

289 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.



It's easy to get these free catalogs—just circle item numbers of those wanted on the two post cards provided on pages 113-114

290 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

291 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Explains how high speed operation on heavy shorts limits current to safe values; how fuse minimizes equipment damage, reduces dangerous stresses

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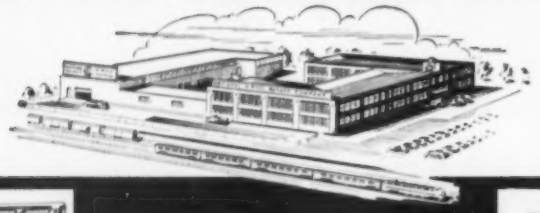

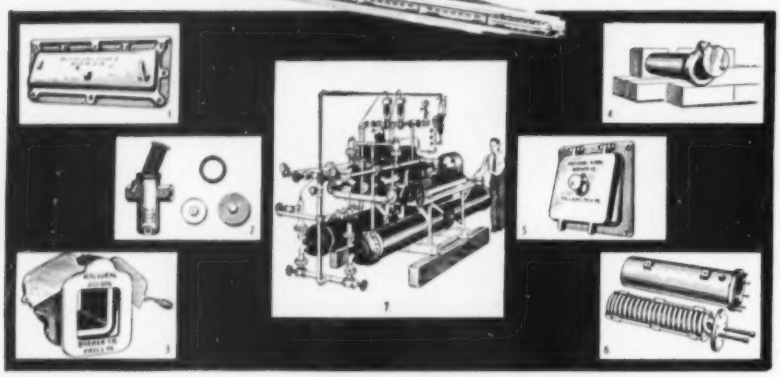

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in transformers, and protects inadequate circuit breakers. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

292 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

OTHER EQUIPMENT

293 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

294 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

295 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

296 Preheating Combustion Air — How to reduce fuel consumption as much as 30 per cent by preheating combustion air for process equipment is told in this 12-pp bulletin. Discusses advantages of increased production, improved product quality, and reduced maintenance. Includes tables of operating data, photos and diagrams of typical installations and a chart for determining fuel savings. Air Preheater Corp.

297 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures. Foster Wheeler Corp.

298 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for large and small condensers; condenser-tower with tables showing parts, dimensions and ratings in tons refrigeration. Henry Vogt Machine Co.

299 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

300 Dry Ice Converters — This illustrated bulletin describes pressure vessels with removable closures into which dry ice is charged and in which the resulting

carbon dioxide is stored indefinitely under pressure. Gives advantages of CO_2 for purging or use as an inert gas, and advantages of the dry ice converters as a source of CO_2. Includes installation suggestions. Dry Ice Converter Co.

301 Specialized Scale Removal — This bulletin explains company's method of removing scale from water and gas lines with liquid cleaning solvents. Cites cleaning of oil refinery's waterlines in 38 hours with minimum service interruption, and without need of digging up buried lines. Dowell Inc.

302 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

303 Communication Systems — Sixteen-pp Form P831 presents communication systems engineered for power plants. Advantages of such a system are given and photos show it in use in turbine rooms, boiler rooms, control rooms, laboratories and outdoors. Amplifiers, handsets, speakers, wall baffles, signal lights, switches and master control equipment incorporated in these systems are covered in detail. RCA Victor Div., Radio Corp. of America.

304 Industrial Products Guide — Newest edition of this company's industrial products catalog is a 40-pp book offering essential data on insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, and others. Photos, diagrams, and text have been revised and brought up-to-date to provide the latest information on these products. Johns-Manville.

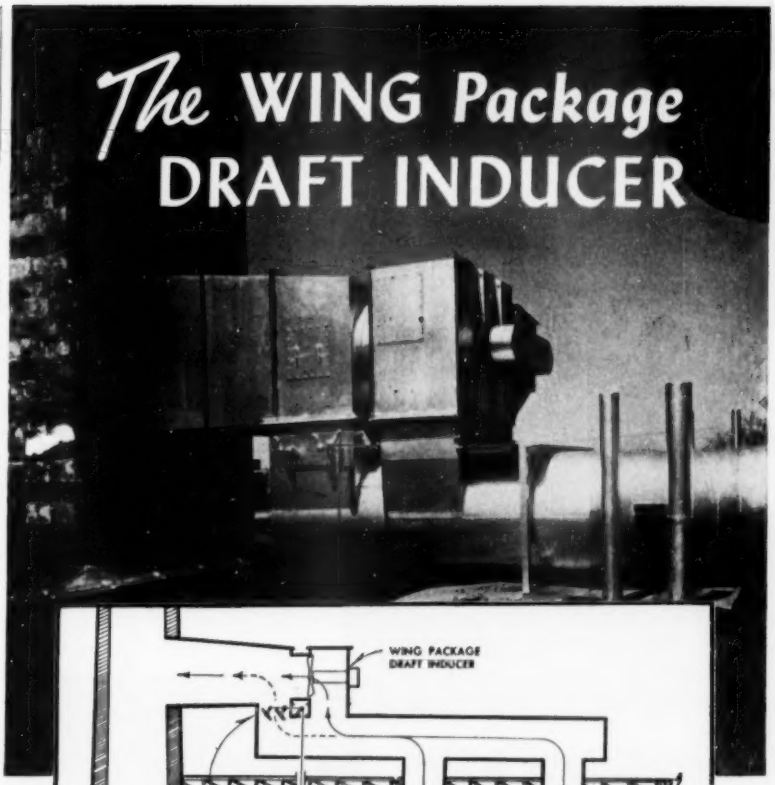
305 Better Brushcutting — A lightweight brushcutting machine for efficient and economical right-of-way clearance work is described in this bulletin. Explains speed, easy operation, and safety of this 35-lb machine, shows how it cuts labor costs. Brushmaster Saw, Inc.

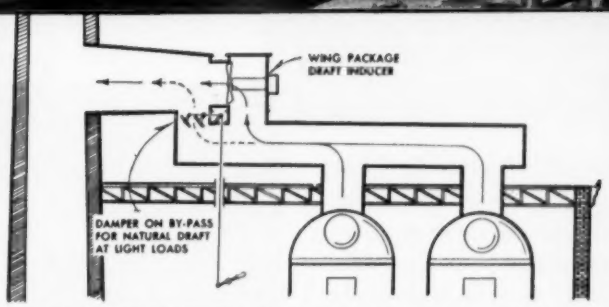
306 Automatic Soot Blowing — Bulletin 483 provides 16 pp of basic information about Vulcan automatic and automatic-sequential soot blowing. Includes a wide variety of typical installation drawings to show complete cleaning systems. Copes-Vulcan Div., Continental Foundry & Machine Co.

307 Heat Transfer Tables — Now available to qualified power engineers is a 44-pp book of heat transfer tables. They were prepared to provide a quick and reasonably accurate means of estimating amount of heat transfer surface required in the heat exchangers, coolers and condensers of a chemical plant or oil refinery. Alco Products Div., American Locomotive Co.

308 Copper and Corrosion — Information on corrosive attack on copper and copper alloys is presented in Publication B-36R, a new 28-pp revised edition of company's booklet, "Corrosion Resistance of Copper and Copper Alloys." Explains chemical and physical nature of corrosive attack in its various forms, and provides a tabulation showing the relative corrosion resistance of the principal types of copper and copper base alloys in contact with corrosives. The American Brass Co.

The WING Package DRAFT INDUCER





WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

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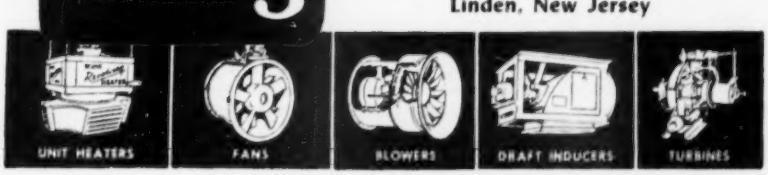

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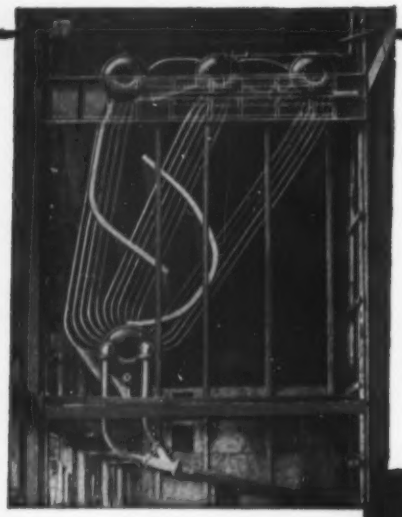
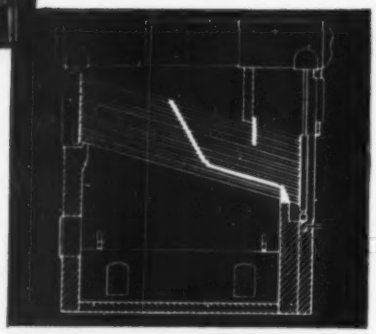
QUICKLY EASILY



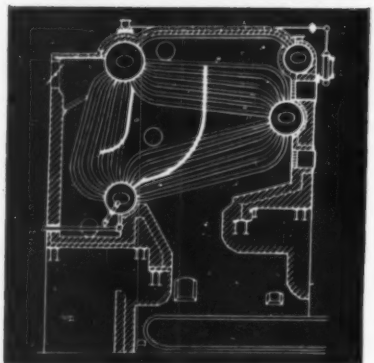
Steam output can be boosted quickly and easily by installing Enco baffles. These streamlined baffles prevent eddy currents and dead gas pockets. The cross-flow puts every square foot of heating surface to work.



Enco baffles reduce draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are more effective and used less often.

Each application is individually designed on the basis of 25 years experience with Enco baffling in all types of water-tube boilers.

Installations are made by skilled mechanics with selected materials.



FREE BOILER BAFFLES

● *A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.*

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Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

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De-Oiling Water

continued from page 110

priming, tube loss through overheating, or some of many other such troubles.

ABMA has a standard guarantee specifying that the total quantity of oil or grease or substances which are extractable, either by sulfuric ether or by chloroform, shall not exceed 7 ppm in the boiler water when the sample being tested is acidified to 1 per cent HCl.

Frequently, simple physical separation of oil from steam must be augmented with condensate oil removal. This is especially true wherever the lubricating mineral oil contains a small percentage of a compounding material or fatty oil.

Although the usual mechanical or skimming-type oil separators can reduce free oil concentrations to values lower than 10–40 ppm, this is not low enough for good boiler operation. In addition, hot wells may be filled with coke, sponges, excelsior, and such, to reduce oil even further.

Preformed Floc Filter

Chemical coagulation and filtration are required for the removal of emulsified oil from liquid condensate. Aluminum and iron salts are usually employed for this purpose. Absorption with diatomaceous earth filters of the leaf type has also been employed in some cases, but the most widespread equipment is still the so-called preformed floc oil removal filter.

This type of filter reduces oil to a very low value (less than 0.2 ppm) by the use of aluminum hydroxide floc fed continuously at a ratio of 0.2–0.5 ppm floc per 1 ppm of oil to be removed. This filter works best on lower oil concentrations of less than 25 ppm, and easily breaks all emulsions. The preformed floc is produced by mixing alum and caustic soda at optimum pH of about 6 to 7 in a tank, and pumping controlled amounts into the condensate feed line ahead of a simple anthrafilt filter.

The top layer of this filter bed, which is usually 30- to 36-in. deep, is coated with a very thin precoat layer of $Al(OH)_3$. The filter is operated up to a pressure drop of at least 5 psig or up to 1 ppm oil leakage, whichever occurs sooner, before backwashing and recoating. Rotary surface washers are usually employed in this filter design. To get the best quality effluent at all times, it is necessary to avoid penetration of oil into the lower layers of anthrafilt.

Table IV shows operating data for preformed-floc-type filters based on actual plant installations. Installations of this type are generally lowest in first cost and operating cost, and for this reason are favored in most feedwater applications where removal of emulsified oil from condensate is a problem.

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 APRIL 1954 Number 2

Long-Standing Boiler Sludge Problem Cleared Up

A manufacturer in Western Pennsylvania found the remedy for frequent acid cleaning of low pressure boilers when Hall sales engineer, L. C. Bishop, called on him to discuss the problem of sticky sludge. From the analysis of the feed water and a deposit from the boiler, Bishop recognized that the long-standing difficulty with sticky sludge was due to silica deficiency.

Until Hall was put on the job, alkalinity control and phosphate residuals had been adequate, but an attempt to eliminate the sticky sludge by use of a dispersive had not produced the desired results. Hall service engineer B. Q. Welder instituted treatment with silicate to overcome the silica deficiency. One month later an inspection showed that build up of deposit on the boiler surfaces had been reduced. Accumulations which had not been removed by an acid cleaning job just prior to starting Hall treatment were now being removed by the silicate feed.

The operators found the boiler cleaner than it had ever been. To quote the foreman, "We can see surfaces of the shell that we haven't seen for ten years."

Analytical Chemistry and Spectroscopy Conference

The fifth annual Conference on Analytical Chemistry and Applied Spectroscopy was held in Pittsburgh, March 1st through 5th, by the Analytical Chemistry Group, Pittsburgh Section, ACS, and the Spectroscopy Society of Pittsburgh. R. K. Scott of Hall Laboratories was co-chairman of the Conference-Exposition committees.

The program included sessions in which papers on new developments in analytical chemistry and spectroscopy were presented.

Hagan Corporation displayed Hall Certified Reagents and related equipment, and the new Calgon Speedy-Kit for testing water hardness.

American Power Conference

Sponsored by the Illinois Institute of Technology with the cooperation of a number of universities and technical societies, the American Power Conference was held in Chicago, March 24, 25 and 26. The Conference featured a Diamond Jubilee Dinner celebrating the 75th anniversary of the invention of electric light.

Four sessions of the Conference were devoted to water technology. In one, a paper, "Boilers and Boiler Waters—Interlocking Advances in Design," by H. M. Rivers and S. B. Osborne, was presented by Mr. Osborne, Staff Engineer of Hall Laboratories.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Thorough Study Solves Boiler Problem

On the basis of a single and inaccurate raw water analysis, a manufacturing plant in the midwest installed a sodium cycle softener. Only when construction was finished was Hall Laboratories called in. The Hall engineers, in starting up the boilers, advised the plant engineers that the pretreatment equipment was not suitable for their particular conditions. However, since the boilers were ready to go on the line, it was decided to try to operate. Then real trouble set in.

Contrary to the original analysis, the raw make-up water had a high bicarbonate content, so that the sodium cycle softening resulted in extremely high boiler-water alkalinity. Carryover and the necessity for excessive blowdown were only the beginning of the problems involved. Serious corrosion in the condensate piping occurred because of high carbon dioxide in the steam.

At this point it was evident that a complete study of the water problems had to be made if satisfactory conditions were to be established. Beginning with analyses of the plant water and carrying through to recommendations for the best equipment to prepare the water for its intended use, Hall headquarters engineer L. Highley considered all the existing factors in making the survey. Revamping of the entire pretreatment setup to provide dealkalization is now under way.

A survey prior to plant construction could have provided for the right equipment to do an efficient job at a cost far lower than the outlay entailed in the revision of the initial setup.

NEW ENGINEERING BOOKS

Electrical Design of Hydro Plants, United States Tennessee Valley Authority Design of TVA Projects (Technical Report No. 24, Vol. 2); 449 pages, size 6 by 9¼ ins.; cloth binding. For sale by the Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn. Price $2.25 (Buckram).

This is the fifth of a series of special technical reports covering important phases of engineering and construction work on all projects designed and constructed by TVA. This book explains the engineering work involved in the design of electrical installations for the primary water control structures of TVA, including switchyards constructed at the hydro generating stations but not transmission lines or substations.

The introduction describes the Tennessee River System, the start and rapid development of TVA's generating station designs, and the organization of its design division, particularly its electrical design branch.

A chapter on generating stations discusses the electrical design of each generating station, the number and capacity of generating units, number and voltage of transmission line connections, topography of the sites, and general arrangement of each project.

In addition to discussing the larger features of each station, the selection, design and arrangement of electrical components such as low-voltage switching, transformers, high-voltage switching, controls, wiring, and accessories are discussed in some detail.

Methods of inspection, testing, and preliminary operation of a completed generating unit and its auxiliaries are described, and at the end of the book four appendices present typical specifications and principal data of TVA's hydro generators, transformers, circuit breakers, and switchboards.

* * *

The Radiant Universe, by George W. Hill. First edition; 489 pages, 6¼ by 9¼ in.; cloth binding. Published by the Philosophical Library, 15 E. 40th St., New York, N. Y. 1953. Price $4.75.

This book presents an entirely new way of looking at natural phenomena based upon viewing all things in the universe as consisting solely of radiation. Such a basis is shown to provide us with rational solutions to the problems of origin presented in many fields of inquiry. This line of investigation is followed through to considerable length to demonstrate its superiority over the older approach from a materialistic standpoint.

The volume is divided into six books or sections. Book 1 is devoted to radiation, Book 2 to the stars, Book 3 to origins in the solar system, Book 4 to origins in the earth, Book 5 to Galactic systems and Book 6 to the subject of gravitation.

Elements of Electrical Engineering, by Arthur L. Cook and Clifford C. Carr. Sixth edition; 682 pages, 6¼ by 9¼ in.; cloth binding. Published by John Wiley & Sons, Inc., 440 4th Ave., New York, N. Y. 1954. Price $6.75.

The first edition of this book was published 30 years ago by the first of the authors, Arthur L. Cook. It dealt with the fundamentals of electrical engineering and their application in practice; the book was intended as a short course for electrical students and also for non-electrical students in colleges.

To a large extent, as explained in the preface to this 6th edition, the aim of the first edition has always been retained in all the later editions — a very large core of the basic material of the first edition is included. Because of the great advancements in the electrical engineering field and in the educational methods of presentation of the art, it was felt necessary to practically rewrite the text for the sixth edition. The objectives of the text and the underlying philosophy of presentation remain the same namely; a clear, accurate and understandable presentation of the basic principles of electrical engineering and their application in a manner which will bring out the physical significance of a result and not depend merely upon a mathematical derivation of a formula.

The space devoted to electronics has been increased, resulting in a better balance between circuits, machines, and electronics.

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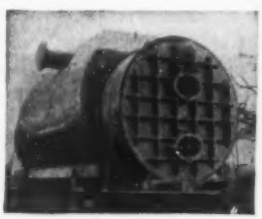

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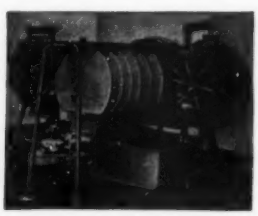

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The illustrations have been extensively revised and many new illustrations have been added. They bring the work completely up to date and increase the clarity and effectiveness of the presentation. Every effort has been made to guard against the mere accumulation by the student of a mass of information through memorizing and the resultant formula pushing.

Arthur L. Cook was formerly Director, School of Science and Technology, of Pratt Institute; Clifford C. Carr is Chairman of Curriculum and head of the Department of Electrical Engineering at Pratt Institute.

On the whole, this is a very readable and interesting book and it presents the facts with a minimum amount of mathematical treatment.

* * *

Viscosities of Natural Gas Components and Mixtures, by N. L. Carr, 60 pages; illustrated; size 8½ by 11 in., paper binding; Research Bulletin 23. Published by The Institute of Gas Technology of Illinois Institute of Technology, Technology Center, Chicago 16, Ill. Price $5.00.

Results of the experimental determination of the absolute viscosity of methane and three natural gas mixtures at pressures up to 10,000 psi, and temperatures from 70 to 250 F, are presented in this bulletin.

The data, important in many calculations involving fluid flow, particularly in the flow of gas out of, or into underground reservoirs, and in pipeline transmission, are presented as viscosity-pressure isotherms showing the effects of temperature, pressure and composition on viscosity. They are correlated in the form of reduced viscosity and viscosity ratio charts.

* * *

Mineral Wool Specification and Standards, by the Industrial Mineral Fiber Institute Inc.; 100 pages, illustrated; size 6 by 9 in.; loose leaf; flexible fabricoid binding. Published by Industrial Mineral Fiber Institute Inc., 441 Lexington Ave., New York 17, N. Y. Price $3.50.

Here is an enlarged, up-to-date fourth edition of this handbook. It is designed for use on design tables and in the field, to guide buyers and engineers, superintendents, specification writers and contractors in the proper selection of materials and in application practices for government contracts and as a basis for insulation specification within industry itself.

The book includes 24 specifications and standards: seven by the ASTM, two by the U. S. Maritime Commission, eight federal specifications and three commercial standards. Four military specifications on mineral wool blankets, blocks and boards, felts and insulating cement had not been issued at the time the previous edition of the handbook was published.

Each specification is listed in the index under type of mineral wool insulation, of which there are eight basic types and types of service high or low temperature. Specifications by each of the five sources are put together in tabbed sections.

Subjects helpful in specifying and installing mineral wool insulation are: types of products, physical characteristics, selection, standard dimensions, temperature use limits, recommended thicknesses, auxiliary materials, application techniques, and test methods.

* * *

Handbook of Standard Time Data, by Arthur A. Hadden, president, McClure, Hadden & Ortman, Inc., and Victor K. Genger, vice-president; 473 pages, size 6 by 9¼ ins.; cloth binding. Published by The Ronald Press Company, 15 East 26th St., New York 10, N. Y. Price $10.00.

About fifty years ago Frederick W. Taylor set forth the principle that methods in machine shop work should be determined by management rather than left to the judgment of the workman. Although few managers today would disagree with this principle, comparatively few shops accept it as part of shop policy to the extent of predetermining feeds and speeds as well as the time and methods required for the manual manipulation of the machine.

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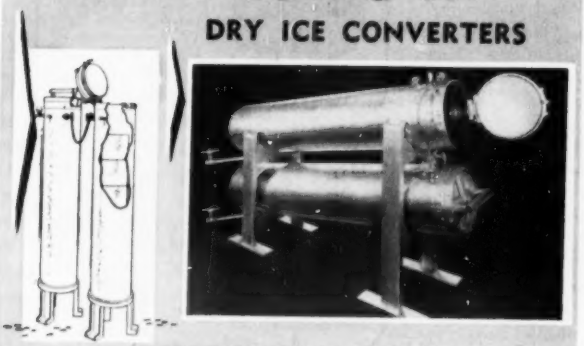

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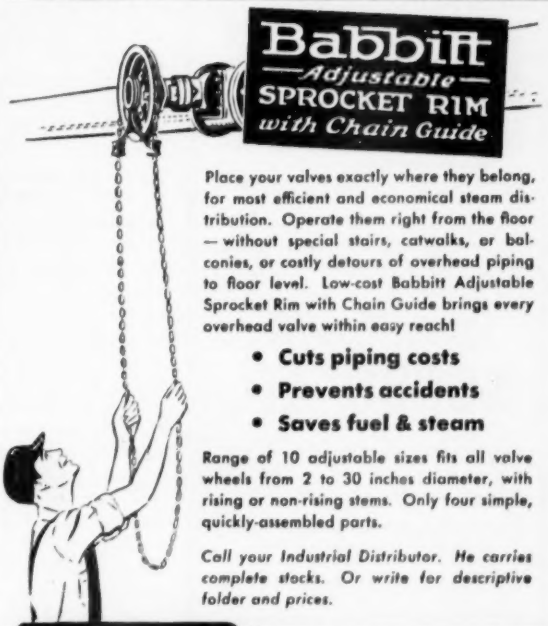

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times and the handling of parts, is left to the machine operator. They came to the conclusion that the cause was lack of reliable, accessible, and simple data which could be used not only for reference but also for setting up the job to obtain the lowest production cost.

This book has been written in order to supply this need. It contains an enormous amount of accurate and practical data which can be used quickly and easily. Wherever possible the data has been represented in tabular form. These tables can be used in bid and quotation work, to prepare estimates and to calculate sub-contract work; in production planning, to establish realistic schedules and to determine individual and departmental loads; they can be used to promote efficient shop management by helping to establish uniform production schedules, and in wage administration they are invaluable in establishing incentive plans, piecework, measured day work, and other shop practices. In cost work they offer an opportunity for establishing standard costs for standard operations in a machine shop.

The book is divided into fifteen parts, each one covering a prominent phase of machine shop operation. These are: — Machinability of Metals; Handling Elements and Allowances; Lathes (Turning); Milling; Drilling; Grinding; Precision Boring; Broaching; Horizontal and Vertical Boring Mills; Planers and Shapers; Punch Presses; Arc Welding; Gear Cutting; Assembly and Power Sawing.

An appendix at the end contains tables on combined manual elements, checking frequency for inspections, production time tables, examples of standard development, and a glossary of terms used in standard data.

This book contains an enormous amount of carefully prepared data, and it should prove invaluable to anyone engaged in machine shop practice.

* * *

An Introduction to Power System Analysis, by Frederick S. Rothe. First Edition; 187 pages, 6 by 9¼ in.; cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. 1953. Price $5.00.

A practical, usable work, this book covers all the important elements that must be considered in the design of the modern electric power system. In this single volume the author consolidates all the basic tools of analysis developed in the past 20 years.

In treating the subject, the author considers the characteristics of each of the building blocks of the modern power system — generator, transformer, transmission line and load. He offers reliable information on such aspects of the field as synchronous machine theory, transformer theory, transmission line theory, symmetrical components and stability. While the book covers problems associated with the fundamental operating frequency, transient behavior of the components of the system during disturbances is thoroughly investigated.

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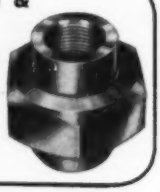

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Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.

Heat 100 linear feet of alloy steel pipe to 1000°F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

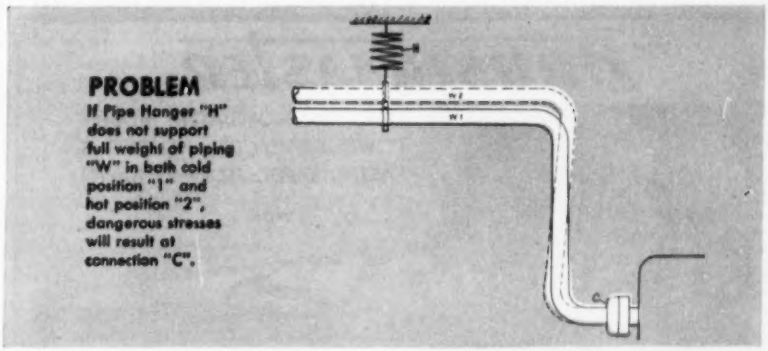
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

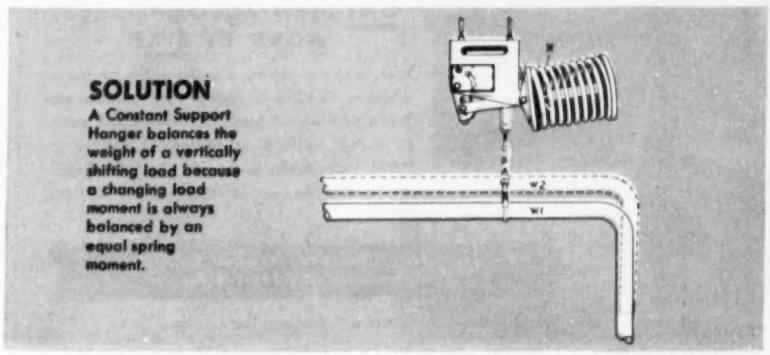
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

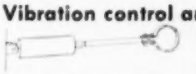

PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

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The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

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Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

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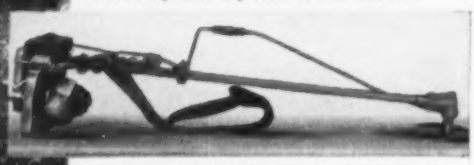

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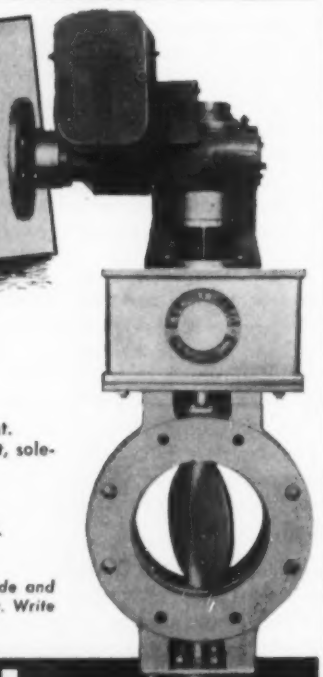

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Frederick S. Rothe is an engineer in the analytical engineering section of the General Electric Company at Schenectady, N. Y., and this book is one of the General Electric series written for the advancement of engineering practice.

The broad coverage of the book provides an excellent basis for advanced work in any phase of the subject and gives at the same time, enough information to solve most of the problems which arise in the work of the practicing power system engineer. No background in any of these subjects is called for beyond that of the usual undergraduate mechanical or electrical engineering course. As an added feature of the book's usefulness there are many worked examples and problems included at the end of each chapter.

★ ★ ★

Money in Exports, by Walter Buchler. First edition; 192 pages, 5 by 7¼ in.; cloth binding. Published by Walter Buchler, 101 Leeside Crescent, London, NW 11. $3.00.

This is a valuable little book to all engaged in industry, trade or commerce. Whether you are a manufacturer, merchant, banker or exporter, you will find useful and profitable material in this book. Each chapter deals with a different market, local methods and business practices, the dangers and pitfalls to be avoided, and how trade can be developed with that country.

★ ★ ★

A History of the Theories of Aether and Electricity, Volume 2, The Modern Theories 1900 to 1926, by Sir Edmund Whittaker; 1st edition, 319 pages, 6¼ x 9 ins.; cloth binding. Published by the Philosophical Library, Inc., 15 E. 40th St., New York, N. Y. 1954. Price $8.75.

Some two years ago, in 1952, we published a review of Volume 1 of this astonishing work. This is Volume 2. These books are astonishing not only because of their content — the complete and copiously documented history of the whole of theoretical physics from the earliest beginnings up to the present — but also because the author has undertaken the task of writing this vast work at the age of 80.

The first volume of Sir Whittaker's history dealing with the classical theories up to the year 1900, was originally published in 1910 and was re-issued in a revised and up-to-date version in 1951. As the author said in the preface to the 1951 edition (reviewed in these pages in 1952), he had long intended to write a second volume but had had no time for it while he was Professor at the University of Edinburgh, a position he held from 1912 to 1946. When, after this interlude of 34 years, he again took up the task, he found that so much had happened in the meantime that three volumes rather than two would be required. So Volume 2 takes the story only up to 1926 and Volume 3 will take it up to 1950. As already mentioned, the first volume dealt with the classical theories up to 1900. The tempo of scientific development was slow up to that

time and a theory or an argument between two conflicting theories could hold the field for a long time—as much as 100 years. Towards the end of the 19th century, however, with the discoveries of Roentgen, Becquerel and the Curies, and the later development of the quantum theory, the speed of progress in scientific matters accelerated vastly. Up to 1900, the theories were to some extent the result of chance discoveries. After 1900 the leaders of physics were groups of mathematically-trained minds working consciously towards certain goals.

As a consequence, Volume 2 is quite different from Volume 1. It reflects faithfully the different climate of the two periods the respective volumes cover. Volume 1 deals with personalities and the historical accidents which gave rise to the various theories.

Volume 2 is more scientific and logical in its scope. It discusses logically the sequence of events which led up to the theory of relativity and quantum mechanics. It gives only brief mention of such familiar events as the Michelson-Morley experiment or Millikan's work on the isolation of the electron. Yet it takes the results of both of these events into consideration. Volume 2 is essentially a mathematical textbook. It outlines the theory of relativity, it describes the development of the quantum theory, the discoveries of matrix mechanics and wave mechanics. The mathematics involved in this section is quite formidable to say the least. Nevertheless, the book has great appeal for the historically-minded student.

Volume 2 begins with Becquerel's discovery of radio-activity. From this beginning, Sir Edmund describes the growth of experimental atomic physics to the artificial transmutation of atoms by Lord Rutherford. The basic concepts developed by these early discoveries laid the foundations for the detailed theories of atomic structure which came later. With this introduction the rest of the book is concerned mainly with theoretical and mathematical developments.

Significantly, Sir Edmund himself lived as a working scientist throughout the entire development he describes. He gives references to about 1,000 papers, studied presumably at the time they were published.

* * *

Fundamentals of Electronic Motion, by Willis W. Harman; 1st edition, 319 pages, 6¼ x 9¼ ins.; cloth binding. Published by the McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York, N. Y. 1953. Price $6.50.

Many educators feel that the answer to the problem imposed by the fabulously increasing body of engineering knowledge is increased concentration on general philosophy, understandings and attitudes with a consequent decreased emphasis on current engineering practice and specific design technique. As the author points out, this book is written in that spirit.

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tubes; for the student whose primary aim is to gain general understanding, rather than specialized information. For this audience, "What Is Done?" is not nearly so important as "Why It Is Done This Way."

In this respect, this volume is quite different from nearly all of the existing books on electronics. For example, there are available books on various types of electron tubes — cathode ray tubes, electron microscopes, television pick-up tubes, klystrons, magnetrons, traveling wave tubes, etc. There are even books on separate parts of electron tubes.

This book does not deal with any particular category of tubes; rather it covers the basic operation of all types of tubes. The author has made a very sincere attempt to extract from the volumes of available material the essential philosophy of electron tube analysis. And indeed, there is no branch of electrical engineering better adapted to demonstrate the philosophies and techniques of mathematical physics than electron tube analysis. Particle dynamics, electromagnetic fields and wave phenomena are all represented. The mathematical tools of ordinary and partial differential equations as well as the approximate methods to be used when these fail, find repeated application.

After an introductory chapter on electric and magnetic field distributions with the relatively simple problem of finding the trajectory of a single electron in a constant electric field, the book proceeds through electron motion in magnetic fields, electron optics, static space charge problems, motion in time varying fields, the concept of space charge waves, and the applications in various types of devices.

Although the presentation is mathematical in nature and the solution of both ordinary and partial differential equations is carried out in the text and required in the problem, no initial knowledge of mathematics beyond the calculus is assumed. The mathematical techniques are explained as they are needed.

Willis W. Harman is Associate Professor of Electrical Engineering at Stanford University, California, and this book is one of the McGraw-Hill Electrical and Electronic Engineering Series edited by Frederick Emmons Terman.

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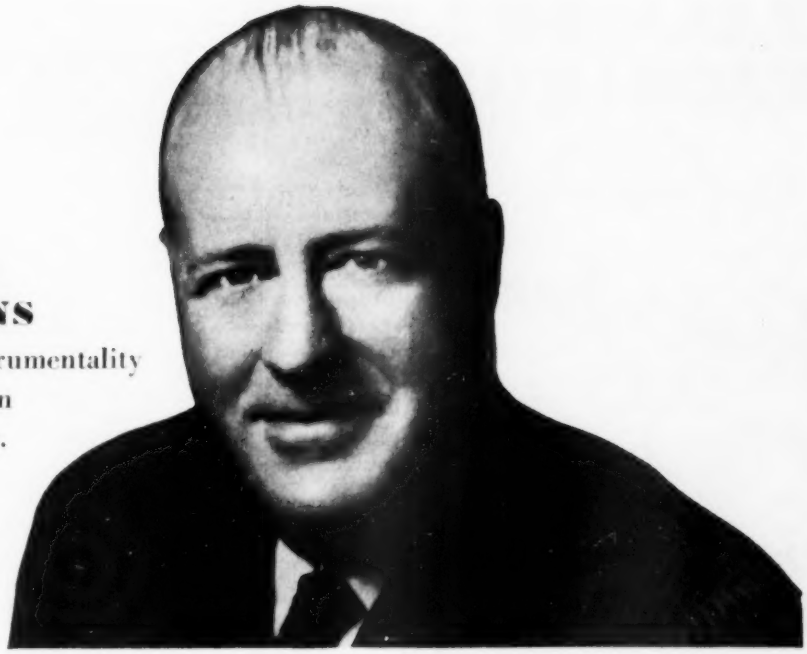

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AMERICAN CHAIN & CABLE CO., INC. 120
Agency—Reincke, Meyer & Finn, Inc.
AMERICAN CHIMNEY CORP. 145
Agency—Brooke, Smith, French & Dorrance, Inc.
AMERICAN ENGINEERING CO. 20
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AMERICAN PULVERIZER CO. 107
Agency—Batz-Hodgson-Neuwoehner
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Agency—Will Inc.
ARMSTRONG MACHINE WORKS 2
Agency—Russell T. Gray, Inc.

BABBITT STEAM SPECIALTY CO. 141
Agency—George T. Metcalf Co.
BABCOCK & WILCOX CO., THE 131
Agency—O. S. Tyson and Co., Inc.
BABCOCK & WILCOX CO. (TUBULAR PRODUCTS DIV.) 57
Agency—O. S. Tyson and Co., Inc.
BAILEY METER COMPANY 117
Agency—Fuller & Smith & Ross, Inc.
BALEWIN-HILL CO. 106
Agency—Eldridge, Inc.
BALTIMORE & OHIO RR. 45
Agency—Richard A. Foley, Inc.
BARNSTEAD STILL & STERILIZER CO. 115
Agency—Copley Advertising Agency
BELMONT PACKING & RUBBER CO., THE 148
Agency—McNevin-Wilson-Dalldorf, Inc.
BETZ, W. H. & L. D. 89
Agency—The Michener Co.
BIDDLE CO., JAMES G. 132
Agency—The Roland G. E. Ullman, Inc.
BITUMINOUS COAL INSTITUTE 109
Agency—Benton & Bowles, Inc.
BOWSER, INC. 110
Agency—Willis S. Martin Company
BRIDGEPORT BRASS CO. 100
Agency—Hazard Advertising Company
BRUSHMASTER SAW, INC. 144
Agency—Chambers-Wiswell Inc.
BUSSMAN MFG. CO. 38–39
Agency—Henderson Advertising Co.

CAMBRIDGE INSTRUMENT CO., THE 149
Agency—E. M. Freystadt Associates, Inc.
J. A. CAMPBELL CO. 149
Agency—The McCarty Co.
CATAWAISS VALVE & FITTINGS CO. 142
Agency—Charles E. Williams Advertising
CHAPMAN VALVE MFG. CO., THE ..... Inside Back Cover
Agency—Sutherland-Abbott
CHESAPEAKE & OHIO RAILWAY 102
Agency—Robert Conahay, Inc.
CITIES SERVICE OIL CO. 93
Agency—Ellington & Company, Inc.
THE CLARK MFG. CO. 108
Agency—Belden & Hickox
CLEAVER-BROOKS COMPANY (BOILER DIV.) 122
Agency—Klau-Van Pietersom-Dunlap Associates, Inc.
COMBUSTION ENGINEERING, INC. 22–23
Agency—G. M. Basford Company
CONDENSER SERVICE AND ENGINEERING 140
COPES-VULCAN DIVISION, CONTINENTAL FOUNDRY & MACHINE COMPANY 36
Agency—Davies and McKinney
CRANE CO. 43
Agency—The Buchen Company

DART UNION CO. 124
Agency—Sutherland-Abbott
DEARBORN CHEMICAL COMPANY 104–105
Agency—The Buchen Company
DE LAVAL SEPARATOR CO., THE 112
Agency—Donahue & Coe, Inc.
DE LAVAL STEAM TURBINE CO. 56
Agency—Michel-Cather, Inc.
DETROIT STOKER COMPANY 150
Agency—Witte & Burden
DOWELL INCORPORATED 27
Agency—MacManus, John & Adams, Inc.
DRY ICE CONVERTER CORP. 141
Agency—Wilson Advertising Agency

EDWARD VALVES, INC. 34–35
Agency—Marstelier, Gebhardt & Reed, Inc.
ELLIOTT CO. ..... Inside front cover
Agency—Peterson & Kempner, Inc.
ENGINEER CO., THE 138
Agency—Michel-Cather, Inc.
ERIE CITY IRON WORKS 54–55
Agency—Davies and McKinney

FOSTER WHEELER CORP. 10–11
Agency—Rickard & Co., Inc.
FULLER COMPANY 52
Agency—O. S. Tyson and Company, Inc.

GENERAL CABLE CORP. 125
Agency—Hicks & Greist, Inc.
GENERAL ELECTRIC COMPANY 58–59
Agency—G. M. Basford Company
GRAVER WATER CONDITIONING CO. 121
Agency—Michel-Cather, Inc.
GRINNELL CO., INC. 143
Agency—Horton-Noyes Company
GULF OIL CORP. 41
Agency—Young & Rubicam, Inc.
GUSTIN-BACON MFG. CO. 32
Agency—Valentine-Radford

HAGAN CORPORATION 98–99
Agency—Ketchum, MacLeod & Grove, Inc.
HALL LABORATORIES, INC. 139
Agency—Ketchum, MacLeod & Grove, Inc.

INSTROF, INC. 126
Agency—R. E. Lovekin Corp.
INTERNATIONAL NICKEL COMPANY, INC., THE 133
Agency—Marschalk & Pratt Co.

JOHNS-MANVILLE 91, 142
Agency—J. Walter Thompson Company

KOR CORPORATION 145

MANNING, MAXWELL & MOORE, INC. 18–19
Agency—Fuller & Smith & Ross, Inc.
MILTON ROY CO. 123
Agency—Harris D. McKinney, Inc.
MINNEAPOLIS-HONEYWELL REG. CO. 50–51
Agency—The Aitkin-Kynett Co.

NATIONAL AIROIL BURNER COMPANY, INC. 136
Agency—R. E. Lovekin Corp.
NATIONAL ALUMINATE CORPORATION 24
Agency—Armstrong Advertising Agency
NICHOLSON & CO., W. H. 49
Agency—Wilbur A. Myers

PEABODY ENGINEERING 30
Agency—Richard La Fond Advertising Inc.
PITTSBURGH PIPING & EQUIPMENT CO. 95
Agency—W. S. Hill Co.
POWELL VALVES 21
Agency—The Ralph H. Jones Co.
PREFERRED UTILITIES MFG. CORP. 146
Agency—Spooner & Kriegel
PROPORTIONEERS, INC. 4
Agency—Hammond-Goff Co.

RELIANCE GAUGE COLUMN COMPANY 118
Agency—Carr Liggett Advertising, Inc.
REPUBLIC FLOW METERS CO. 16–17
Agency—Glenn, Jordon, Stoetzel, Inc.
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Agency—St. Georges & Keyes, Inc.
RIC-WIL CO. 128
Agency—Ritchie & Lattler, Inc.
W. S. ROCKWELL CO. 144
Agency—Spooner & Kriegel
ROTO DIV. OF ELLIOTT CO. 28
Agency—Jos. S. Vogel & Co.

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Agency—Harris D. McKinney, Inc.
SCOVILL MFG. CO. 129
Agency—Edward W. Robotham & Co.
SHELL OIL COMPANY 29
Agency—J. Walter Thompson Co.
SIMS PUMP VALVE CO. 145
Agency—Michel-Cather, Inc.
SINCLAIR REFINING CO. 119
Agency—Morey, Humm & Johnstone, Inc.
SPRINGFIELD BOILER CO. 127
Agency—Armstrong Advertising Agency
STEPHENS-ADAMSON MFG. CO. 12–13
Agency—Glenn-Jordan-Stoetzel Inc.
STONE & WEBSTER ENGINEERING CORPORATION. 103
Agency—Harold Cabot & Co., Inc.

TEXAS CO., THE ..... Back Cover
Agency—Erwin, Wasey & Company, Inc.

U. S. ELECTRICAL MOTORS, INC. 115
Agency—The McCarty Co.
UNITED STATES RUBBER COMPANY 31
Agency—Fletcher D. Richards, Inc.

VOGT MACHINE CO., HENRY 40
Agency—Farson & Huff

WALLACE & TIERNAN PRODUCTS, INC. 130
Agency—Branstate Associates, Inc.
WATER TREATMENT COMPANY OF AMERICA 33
Agency—Walker & Downing
WESTERN CHEMICAL COMPANY 116
Agency—Carter Advertising Agency, Inc.
WESTERN PRECIPITATION CORP. 134
Agency—Dozier, Eastman & Co.
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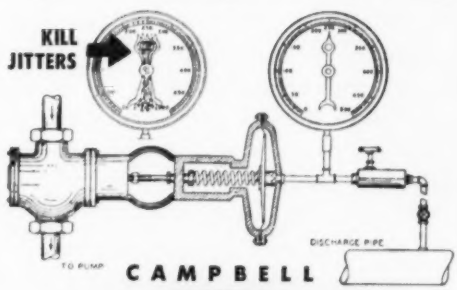

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INCREASES GAUGE & GOVERNOR LIFE

Never install a gauge on a pulsating line without a Campbell Micro-Bean, is edict of many engineers. This miraculous pulsation dampener installed ahead of gauge and governor of a boiler feed-water pump will positively prevent fatigue of spring, rupture of diaphragm and leakage from stem packing. Smoothes out the line. Increases gauge life by ten. U. S. Army used 8000 on portable pipe lines. Most sensitive control to kill gauge jitters. ¼" and ½" to 10,000 lb. Write for literature and prices.

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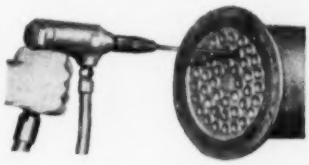
It's a cinch to clean any size heat exchanger tube the Wilson way!

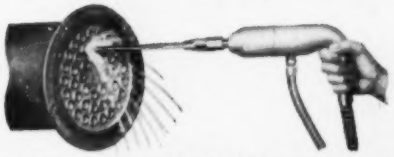
Why put up with the delays and the high costs of makeshift tube cleaning methods? Wilson has exactly the tube cleaner you need to do the job quickly, thoroughly, economically. Wilson's complete line of fast-acting tube cleaners includes the popular PG for ⅜" to 1", the PGX for intermediate sizes ½" to 1½", and the TP-301 for up to 2⅞" ID.

For Small Sizes
MODEL PG
PISTOL GRIP
TUBE CLEANER



The fast, efficient Pistol Grip Tube Cleaner provides the operator with one-hand control for cleaning small, straight tubes. Weighs only 3 lbs—no more than a 12" Stillson wrench.

For Intermediate Sizes
MODEL PGX TUBE CLEANER



Positive drive (not geared down) high speed, rotary shaft, air-driven scavenger type cleaner. Washes out tube and debris as it cleans, keeping drill bit cool at the same time. For either vertical or horizontal applications, straight or curved tubes.

For Heavy-Duty Service
MODEL TP-301
TUBE CLEANER

Suitable for vertical or horizontal use in straight or curved tubes ⅜" ID to 2⅞" ID and up to 40' long. Cleans rapidly, thoroughly, operating at high speed at 90 psi. Can run on pressure as low at 50 psi.

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WILSON

TUBE CLEANERS • TUBE EXPANDERS

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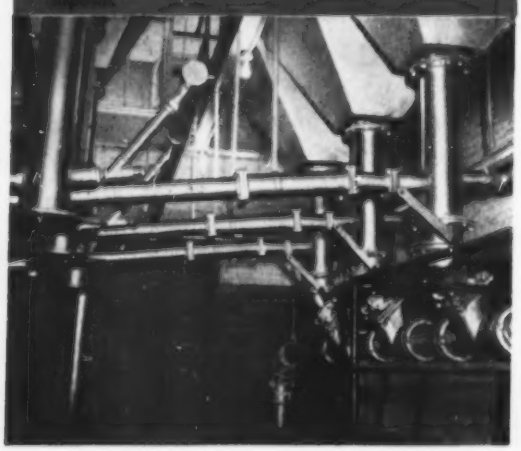
Nash Motors SELECTS
DETROIT ROTOGRATE STOKERS

Front and rear views of one of the two RotoGrate units at Kenosha. Scientifically designed and superbly constructed, Detroit Stoker Cinder Return System has components arranged for return of unburn cinder to the furnace or discharge to ash disposal.



Nash Motors, Division of Nash-Kelvinator Corporation purchased two 100,000 pound per hour RotoGrate Stokers for their Kenosha plant. Boilers are Babcock and Wilcox 4 drum Stirling with superheaters and economizers. A similar stoker unit was purchased for the Nash Milwaukee plant.

Detroit RotoGrate is an improved spreader stoker. Grates move slowly forward to discharge the ash at the front. Coal feed, grate speed and air supply are synchronized at all capacities. A wide range of Bituminous Coal or Lignite may be burned. Controlled high turbulence and rugged, dependable cinder reinjection system contribute to fuel economy. Grates are of unique design which permits more burning capacity per square foot.

Write for RotoGrate Bulletin.

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

District Offices in Principal Cities · Works in Monroe, Mich.

For more data circle 601 on Post Card

Only Chapman's *Tilting-Disc* Check Valves Give You...

NO SLAMMING
LOW HEAD LOSS
LOW WEAR

Here's the check valve that stays open with minimum flow resistance, closes fast without slamming, closes tight without sliding or scraping wear.

Cushioned Closing

Pressure against the upper part of the disc cushions it as it closes. Then the disc *drops tight* to its beveled seat after the valve has swung closed. Both actions are fast, but they are fluid-cushioned. Seating is quiet in all but unusual piping arrangements.

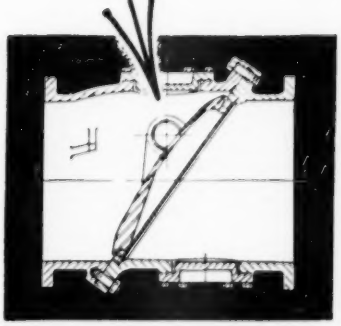
Low Flow Resistance

The streamline design of the valve body and disc eliminate turbulence and cut flow resistance. The fluid holds the disc tightly against its stops, without flutter. The body is larger around the disc, so the net valve area is at least as much as the pipe area.

Minimum Wearing Action

Because the disc *drops* tight, it doesn't slide against the seat. The wear on hinge pins is small because the disc doesn't flutter. Unusually husky construction in every detail means long life under the toughest conditions for Chapman's Tilting Disc Check Valve.

Full engineering and construction data are in Chapman's Catalog #30. Write for it now.



Here's Why CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

The CHAPMAN VALVE Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

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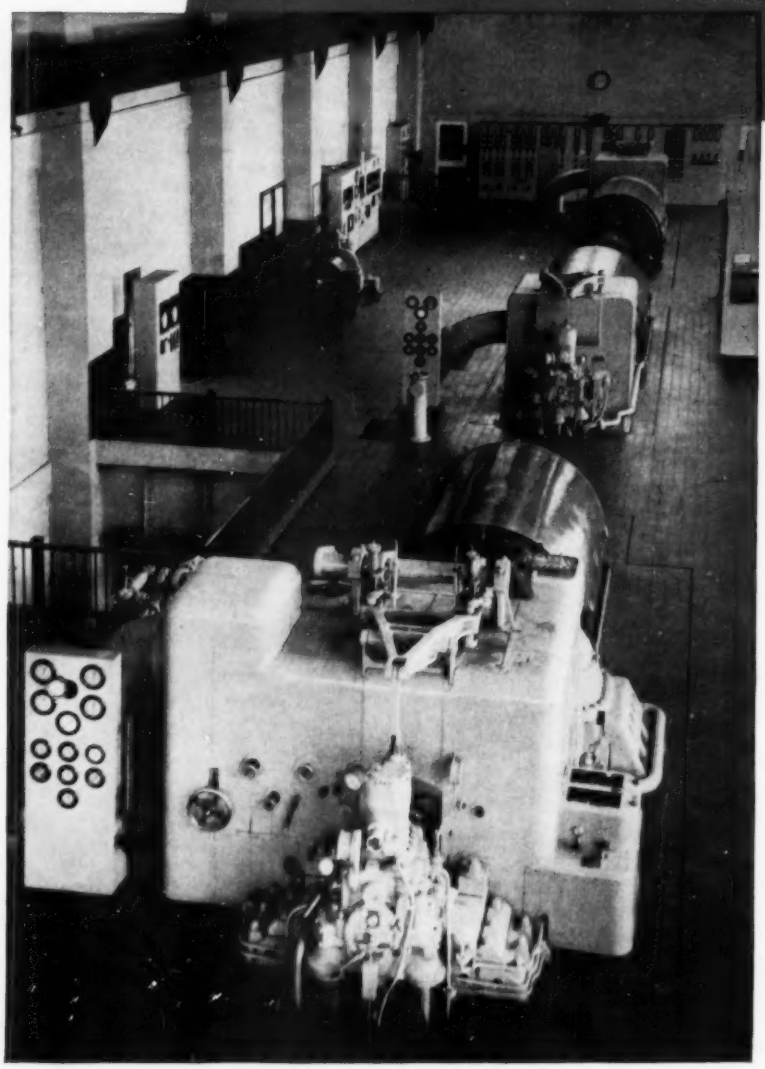
USE THE OIL THAT ASSURES "ADDED" PROTECTION



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Texaco Regal Oil (R & O) is especially refined from top quality base stocks — then *made even better* by powerful inhibitors of oxidation, rust and foam. This "added" protection means you'll have clean systems, normal bearing temperatures, instant governor response.

There is a complete line of *Texaco Regal Oils (R & O)* for every type and size of turbine. They meet the stringent requirements of all leading turbine builders.

A Texaco Lubrication Engineer will gladly help you improve turbine performance. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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